RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

VOL. VII AUGUST, 1926 No. 2

THE X-RAY TREATMENT OF HYPOFUNCTION OF THE OVARY[1]

WITH SPECIAL REFERENCE TO THE REGULATION OF MENSTRUAL FUNCTION

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THE use of the X-ray in some of the diseases associated with disturbed ovarian function is well known. Under a certain dosage, definite changes may be produced, which are known as roentgen castration. This dosage depresses or abolishes the ovarian function controlling menstruation and, by destroying the ova, produces sterility.

Based on a suggestion of Opitz, Van de Velde and Fraenkel, by applying a *fraction* of the dosage required to produce an abolition of ovarian function, were able to induce regular normal menstrual cycles in cases of amenorrhea and hypomenorrhea. If normal regular menstruation and fertility are evidences of normal ovarian function, then delayed, scanty or absent menstruation and sterility may be said to be symptoms of a hypo or a diminished ovarian functional state. The method of treatment to be described has, therefore, been called the stimulative treatment of the ovary, or the treatment of ovarian hypofunction. On the other hand, in certain cases, menstruation—irregular in interval, duration and amount, occasionally scanty and occasionally profuse — cannot be ascribed either to hypo or hyper, but to a dys or a disordered function, in which the X-ray treatment acts as a regulator. This explains the double title of the paper, which concerns itself with the treatment of delayed, scanty or absent menstruation and the sterility usually associated with such symptoms.

The indications for this method of X-ray treatment are circumspectly limited and it is, therefore, important that the diagnosis be established with accuracy. What I have stated in a previous article[2] may pardonably be repeated:

"The gynecologist and the radiologist are both concerned in the application of the X-ray as a therapeutic agent, and a close co-operation between the two is essential if effects are to be obtained and the treatment properly and honestly applied. Without a correct diagnosis, without proper control by the gynecologist, without a proper selection of cases, the radiologist works blindly and often to the detriment of his patient. In fact, the radiologist is but the assistant of the gynecologist, and the keener his diagnostic ability, the closer his scrutiny of the cases, the more effective are the results."

In this particular work, I have been fortunate in having the co-operation and assistance of Dr. A. J. Rongy, to whom I desire to express my indebtedness.

"In reference to the radiologist, there is to be said that he must apply the rays with brains, that, although certain fundamentals must be adhered to, which are the essentials of technic, he must remember that he has a living human being to deal with, who responds and reacts in manifold ways to the

[1] Read before the Radiological Society of North America, at Cleveland, Dec., 1925.

[2] The Roentgen-ray Treatment of Diseases of the Female Generative Organs. N. Y. Med. Jour. and Rec., July 19 and Aug. 16, 1922.

application of this powerful agent, and that as much clinical judgment is necessary in prescribing a dose of radiation as in prescribing a dose of any powerful drug, utilized in medicine."

CLASSIFICATION

The menstrual deficiencies may be classified as follows:

As to cause:

1. Essential, due to changes in the generative organs.
2. Symptomatic, associated with such systemic diseases as chlorosis, tuberculosis, etc.

As to type:

1. Complete cessation — amenorrhea (for months or years).
2. Scanty amount / Normal amount } Oligomenorrhea
3. Normal amount / Prolonged interval } Opsomenorrhea
4. Scanty amount / Prolonged interval } Oligo-opsomenorrhea

As to the time of its inception:

(*a*) At puberty.

(*b*) After a period of more or less normal menstruation.

INDICATIONS

The form of ovarian hypofunction suitable for this therapy may manifest itself as any one of the types of menstrual deficiency above described and as an associated sterility.

In all the types of cases suitable for treatment, there must be direct or indirect evidence that ovarian tissue exists in sufficient amounts to respond to the action of the radiation.

SYMPTOMATOLOGY

The diminished menstruation can be said to present no serious menace to the general health except if there be an associated disturbance of other secretory glands. There is, however, an important consideration in these cases, and that is, the disturbance in the emotional and psychical state of the individual affected, since regular menstruation appears to the average woman to be tangible evidence of ovarian normality.

Thus, if the menstruation has entirely ceased or is rare, or scanty, there may arise an associated state of psychosexual inferiority, which cannot be ignored and which, disturbing the mental equilibrium of an otherwise normal individual, may lead to a general depression, with an associated train of functional neurosis with vasomotor and metabolic disturbances.

Another and greater consideration, associated with disturbed menstrual function, is that of diminished fertility.

TREATMENT

Numerous as have been the forms of treatment for the menstrual disturbance resulting from insufficiency of ovarian function, they have all of them been of so little permanent value that there is justification in stating that there is no medicinal therapy which is definitely able to influence ovarian function. This applies to such medication as aloes, yohimbin and santonin. Nor are such physical measures as baths, thermotherapy, active and passive gymnastics, massage, etc., of any definite value.

The connection of the endocrine glands with the function of the genital apparatus has been recognized in recent years as quite definite for the ovaries, the thyroid, the pituitary, and the adrenal glands. Consequently, the administration of glandular extracts, either single or in combination (for instance, of entire ovary or liquor folliculi, corpus luteum, thyroid, the anterior and posterior lobes of the pituitary gland), has become quite customary in gynecological therapeutics. The results have been, however, neither striking nor permanent.

X-RAY TREATMENT

The treatment consists in the administration of a small dose of radiation to each ovary. The dose necessary to produce the desired effect is 15 per cent of the castration dose delivered to each ovary through two

portals. It is necessary to treat both sides because of the alternate ovulation. The four portals which take in all the pelvic structure may be irradiated at one sitting, or a portal at a time with intervals of a day or two. The series should not be repeated until after a lapse of several months, but meanwhile a small dose of radiation may be applied to the thyroid or the hypophyses if the status of the individual demands it. A slight variation from the 15 per cent may be necessary, depending (1) on the age, (2) thickness of abdominal wall; (3) duration of ovarian hypofunction. There should be no irradiation sickness, and no change in the skin of the portals treated.

It is to be pointed out that X-ray treatment of a patient showing no results must not be continued. The possibility exists that even the relatively small dose, unless carefully administered, may produce permanent amenorrhea in women in the menopause age.

This treatment is, of course, contra-indicated in symptomatic amenorrhea, associated with such general systemic diseases as lues, tuberculosis, nephritis, pernicious anemia, also when secondary to adnexal disease, tumors, or cystic disease of the ovary. Amenorrhea in advanced age or of very long duration, or that resulting from curettages after numerous abortions, does not respond to this treatment. In dystrophy-adiposo-genitalis, the involvement of other endocrines may necessitate other treatment.

ANALYSIS OF RESULTS

Thirty-six cases are here studied. The result of the treatment showed that in twenty-two of the cases treated, menstruation appeared after the treatment and in the majority of cases followed during the entire period of observation, and that the somatic and psychical symptoms of the ovarian hypofunction disappeared rapidly after menstruation set in. The longest period of amenorrhea to be followed by a menstruation after the irradiation was six years. Successful results were obtained in a woman of 30 years (Case 21), who had not menstruated for three years, in a woman of 28, who had not menstruated for two years, and in a woman of 34 years who had not menstruated for seventeen months.

The interval between the first radiation and the menstruation varied, but in the majority of cases it was about twenty-eight days. In two cases the duration was two and three weeks, respectively. It was never less than two weeks. In four cases menstruation appeared seven weeks after the treatment. In Case 2 it appeared ten weeks after treatment, and after eight regular periods this patient became pregnant. In Case 16, a sterile woman of 35, it appeared sixteen weeks after a second partial dose had been given, the first dose—three months before—having failed to produce results.

In some of these cases, simultaneously with the regulation of menstruation, dysmenorrheal symptoms were favorably influenced. In other cases there was no improvement of the dysmenorrhea, in spite of improvement of menstrual function. In some cases the pain with the first menstruation was very severe. In some cases of oligomenorrhea, the increase of the menstrual function was abnormal. Certain cases of hypomenorrhea, in which there was a marked adiposity with the menstrual disturbance, the adiposity was reduced after the onset of menstruation, without any other therapeutic measure. One of these cases lost thirteen pounds after treatment, one lost forty-seven pounds, and one sixty pounds.

PREGNANCY

Besides this, there are seven cases treated for hypomenorrhea in whom, following regular menstrual periods, pregnancy ensued.[3]

[3] Linzenmeier reported the cases of two women who, some time after irradiation of the ovaries (in one case for fibroma and in the other for menorrhagia), both became pregnant and were delivered of normal infants at term. In the first case, the woman received two irradiations over the right abdomen: the second case was treated both abdominally and dorsally. In this latter case, the pregnancy occurred a year later. In both cases weak dosage had been used. Neither of the women previously had had children, although married for several years. Linzenmeier, in eight cases (as reported in the literature) of pregnancy following irradiation, found a malformation of the child in only one case.

All of these cases previously had shown symptoms of a defective ovarian function. Before becoming pregnant there was a period during which the menstruation became regular. The ages were 21, 24, 26, 26, 27, 27, 30. One of these women gave birth prematurely, due to nephritis. One of the cases was a para-I and one a para-II, and five others had never been pregnant before. Two patients (Cases 25 and 35) are now pregnant. Out of five births there were four healthy normal living children.

FAILURES

The treatment failed to achieve the desired result in fourteen cases. Analysis of these cases is of great interest, since it aids in defining the limitation of this treatment. This analysis shows two patients to be 36 years old (Case 3 and Case 10). One of these, Case 3, had menstruated three times in five years and the other, Case 10, had menstruated twelve times in the last eighteen years, her last menstruation having taken place six years before treatment.

Case 8 had, at the age of 24, menstruated only twice, once at 6, and once at 16 years, and had stained once, four months after marriage. There was a history of flushes. The left ovary was not palpable and the right was small and hard. A small sella turcica was present in this case. There was sexual anesthesia. This would indicate a very marked congenital mal-development of the genital tract, with ovarian deficiency. In this category may also be placed the cases of oligo- and opsomenorrhea, which were markedly irregular from the first menstruation, and had the various uterine and ovarian stigmata of undeveloped or degenerated sex organs (Cases 7, 9, 14, 19 and 31).

Case 23 was 30 years old. Her condition remained unchanged after treatment. She spotted for a few hours for one day. Her irregularity began after a miscarriage seven years before treatment. In this case and in Case 5, the cause of the failure was probably an old pelvic infection.

The history of Case 28 dates the oligo-opsomenorrhea from the last childbirth. As a result of the treatment, she had at the next period severe cramps for three days, but the watery discharge for one day was the same as usual. This case had a beginning fibrosis of the uterus and it is probable that there were also fibrotic changes in the ovary.

There were two cases, 30 and 34, treated for sterility. In Case 34, an obese woman with a small, undeveloped uterus, a narrow pelvis and sexual anesthesia, the menses changed from a one-day watery flow to a normal four-day menstruation, and she lost thirty pounds. In Case 30, the menstruation was normal.

MODE OF ACTION

The basis for the application of small doses of radiation to the hypofunctioning ovary was the theory that, whereas large doses destroy cellular structure and moderate doses inhibit cellular proliferation, small doses directly foster and increase cellular growth, and, therefore, stimulate the functional activity of the particular organ.

This is not the time to enter into a discussion as to the correctness of this theory, which never had a solid basis of experimental and clinical fact. Let it suffice to state here, that every dose of radiation, no matter how small, acts detrimentally on a cell, and that far more illuminating and valuable as a working hypothesis is the idea that small doses of radiation repair cellular disequilibration. Cells are naturally so constituted that they respond to disequilibration, provided the disequilibration be not so thoroughgoing as to lead to irreparable injury. According to the sensitiveness and character of the cell complex, the amount and character of the disequilibration which can be repaired varies; the character of the cell complex also decides what kind of equilibrium is re-established and by what means it is accomplished. These means often imply temporary excess activity which appears as a stimulative effect.

The disequilibration associated with the symptoms of hypofunction of the ovary affects the sex cycle, in which follicular

rupture, ovulation, follicular degeneration, the pre-menstrual, menstrual, and post-menstrual uterine changes play an important part.

Though at birth there are thousands of primordial follicles in the ovary, under normal conditions only about 300 go through the cycle of maturation, with corpus luteum formation and final absorption. The remaining ova at one time or another undergo a process called atresia. Of many ripe follicles always to be found in the ovaries of normal women at times other than pregnancy, only one follicle ruptures and expells its ovum, not simultaneously with menstruation, but about fifteen days after the beginning of the menstrual flow.

It would appear that this follicular rupture is not a haphazard, accidental phenomenon or dependent merely on the number and size of the follicles, but takes place under definite control, the ovaries performing this function alternately so that in each ovary ovulation takes place once in eight weeks.

The periodicity of menstruation is directed through the regular recurring cycle of changes in the ovary. The ovary has been compared to the mechanism, the uterus to the hand of the clock, as regards functional relationship. The mucous membrane of the uterus undergoes a regular cycle of morphological changes, which reach their acme with each menstruation. At the time when the follicle ruptures and releases the ovum, the mucous membrane of the fundus is in a so-called rest or inter-menstrual period. Changes now take place known as the pre-menstrual swelling, which show their characteristic expression in the last few days before the expected menstruation. During menstruation, the active compacta and part of the spongy layer of the endometrium are cast off by the continued hemorrhage. About the seventh day after the beginning of menstruation, the mucous membrane is again epithelialized and regenerated, and after another eight days it has grown again to its original thickness. As soon as complete fusion or substitution has taken place, then the new preparation period commences.

The mode of action of the radiation, namely, the mechanism by which the radiation produces the desirable effects, is a difficult problem. In the consideration of this question, it is perhaps important to understand that, as far as the histological changes permit us to determine, there is no such difference in sensitivity of the various ovarian cellular structures as would permit us to reason that a specific effect occurs on any particular part of the ovary. Even with the relatively small dosage administered, the ovarian follicular structure, in all stages of development, the structure of the cortex and medulla, are similarly affected. The effect may be produced through action—

(1) on the corpus follicularis (ruptured follicle),

(2) on the graafian follicle (unruptured),

(3) on the ovarian stroma (hormonal action), or

(4) on the uterine mucosa.

(1) Though the relation of the cause and effect between follicular rupture and uterine changes has not been established beyond all doubt, it is generally conceded that the corpus follicularis from the moment of its rupture, if not before, is a chemically active body until its period of involution or absorption.[4] The corpus follicularis exerts its local influence as a regenerative mechanism governing the chemical metabolic processes and the physical pressure relationships in the ovary so that, through it, the growth and ripening of the remaining follicles are influenced. It may be conceived as being a

[4] According to Loeb there are two factors in the sexual cycle. The first factor is ovarian rather than associated with the corpus luteum. The wall of the maturing follicle secretes a substance which causes circulatory changes, growth processes, certain physical alterations and proliferation in the mammary glands, vagina, and uterine walls, and in a manner is responsible for growth changes in the ovary itself, culminating in ovulation, which leads to corpus luteum formation. The second factor in the sexual cycle is controlled by substances secreted by the corpus luteum. These secretions sensitize the uterus, make possible the formation of decidua or pre-decidual proliferation, and facilitate the fixation and development of the fertilized ovum. They prevent proestrum, estrum, and ovulation. There is an intermediate or degenerative stage between the first and second factors.

sort of inhibiting body only, through the involution of which the remaining follicular apparatus can return to full function. The continued growth of the corpus folliculari during pregnancy may exercise an inhibitory effect on the ripening of the follicles during this period and on the catabolic regression of anabolic phenomena of this fertile sex cycle. Should the corpus be destroyed or removed through extraneous influences, the attachment of the ovum to the wall of the uterus fails.

Aschoff has shown that the ovum leaves the follicle without a trace of hemorrhage, and that the follicle grows and reaches its greatest development in about fourteen days after ovulation, but that it is only coincidently with the uterine bleeding that a characteristic hemorrhage takes place in the follicle; which initiates its degeneration. He has shown that this hemorrhage comes from the rich capillary system of the layer of granulosa luteal cells. The inhibitory function ceases when the regressive changes initiated by the hemorrhage are well advanced, towards the end of the third stage, or fourteen days after the hemorrhage has taken place into the follicle, and then another follicle ruptures.

It is, therefore, obvious that if the menstrual hemorrhage should not take place in the follicle, due, let us say, to a defective formation of the capillary system in the layer of granulosa luteal cells, or even if the hemorrhage does occur, if the degeneration of the luteal cells does not take place, the follicle follows the career of the corpus folliculare graviditatis,—it remains in the blossoming state, at the height of its luteal secretory activity, the retrogression of the follicle is delayed, an inhibitory effect is exercised on further follicular rupture, ovulation is absent, and so is uterine menstruation.

The action of the radiation may be to produce degenerative changes in the corpus luteum, which in fourteen days result in sufficient involution of the corpus to permit a new ovulation and the concomitant premenstrual swelling of the uterine mucous membrane to take place, which in fourteen days after ovulation results in menstruation. Thus, the whole cycle of changes would take twenty-eight days, and in the majority of cases menstruation followed the treatment in twenty-eight to thirty days. It is quite in accord with the changes produced by the radiation on tissues in general. The endothelium of the finer blood vessels is extremely sensitive to radiation. Occlusion of the smaller vessels, with anemic infarction, is among the first changes to be noted, and the highly vascular capillary system of the layer of granulosa luteal cells could be thus rapidly affected.[5]

(2) If, owing to intrinsic or extrinsic causes,[6] the new follicular rupture is delayed[7] or does not occur at all, in spite of the fact that the degeneration of the last corpus follicularis—so necessary to menstruation—has taken place, it is conceivable that the irradiation may aid the rupture of a mature graafian follicle, or produce changes biologically equivalent to a rupture. The irradiation which produces this result must, however, at the same time injure the ovum, which undoubtedly dies. For it is inconceivable that any such difference in sensitivity exists as would leave an expelled ovum untouched. As a result of such changes, the pre-menstrual uterine phenomena are incited, for Frank states that at the time of follicular rupture a concentrated active extract (the follicle fluid) is poured out and rapidly absorbed by the lymphatics. The granulosa of the follicle at this time has no connection with the blood stream, but immediately after ovulation, capillaries penetrate the ruptured follicle and within a few hours the process of vascularization places each secreting cell in intimate con-

[5] Rhodenburg has shown that premature hyalinization of the vascular supply of the corpus luteum impedes the recession of the corpus follicularis. The detritus of the luteal cells is not completely and promptly removed.

[6] In approaching the peritoneal epithelium through which the rupture occurs, the follicle must push aside or distend the connective tissue of the tunica albuginea. Ordinarily this is a weak layer, but in some cases it is more highly developed, and it has been suggested that it may act as an obstruction to ovulation.

[7] Such cases may have periods of metro- or menorrhagia, with a history of amenorrhea.

tact with one or more capillaries. The process once started, the corpus follicularis undergoes its degenerative changes and the cycle is continued. Under these circumstances, the menstruation should take place at the end of fourteen or fifteen days after treatment. This it does in some cases.

(3) Through hormone production from (*a*) the ovarian stroma, or (*b*) other pelvic structures.

(*a*) Through the action of the radiation on the ovarian stroma (interstitial cells), a hormone may be released, which, directly[8] or indirectly through action on other glands of internal secretion,[9] controls ovulation, and pregravid changes in the sex organ.

(*b*) A theory has been expressed that the protein products resulting from the breaking down of the lymphatic tissue of the pelvis may act as an activating agent of the sexual cycle.

It is claimed that these interstitial cells are normally found within the stroma of the cortex. They resemble lutein cells, but are smaller. They have been compared to the interstitial cells of Leydig, of the testes, and are believed to contain secreting granules. They are apparently derived from the theca interna of the atresic follicles.

Steinach and Holzknecht irradiated the ovaries of young guinea pigs and found on histological examination an accelerated destruction of the ova, with atresia of the follicles, and, with this, more or less complete atrophy of the follicles, both young and mature. There was an associated proliferation of the cells of the theca interna, called by them the interstitial cells. Associated with these histological changes, there was not an atrophy, but a marked hypertrophy of the uterus and an acceleration of the development of the sex markings. It was held by them that these uterine changes were evidently the result of hormonal irritation from the markedly proliferated interstitial cells as well as from the direct effect on the uterine tissue.

(4) In the causation of hypomenorrhea, it is not sufficient to consider the ovary as the sole cause: the uterus may also play a part in its causation. Thus, even with normal functioning ova and corpora lutei, though the periodicity of the ovarian function be maintained, there may be menstrual deficiency, if the uterus be small or defectively developed.[10]

It is essential that the mucosa lining the uterus be in an anatomic state capable of responding to impulses arising from the ovary. It is conceivable that if the uterine mucosa is not in such a state, the radiation may induce such changes directly. Congestion of the endometrium can be demonstrated after irradiation. This cannot be

[8] The report of Sippel would tend to corroborate this view. The ovarian fragments from other women were transplanted into the abdomens of sterile women with insufficient menstruation and with amenorrhea. All began to menstruate regularly and three of them conceived. Such a graft stimulates the hypofunctioning ovaries to activity.

[9] There is a close interrelationship between action of the thyroid, thymus, adrenals, hypophysis and the ovary. In fact, substances released, for instance, by radiation of any part of the body, can effectually influence the sexual organs, as shown by the experiments of Poos. Genital hormones may be influenced by radiation of the spleen, or the lymph tissue of the parotid gland (Amreich). A small dose of radiation applied to the thyroid in hyperthyroidism, with amenorrhea, will produce menstruation. On the other hand, Holbauer believes that when the follicle bursts, the follicular liquid produces pituitary changes, acting as a sensitizer—an activator. He points out that modifications of the genital apparatus from other sources have their influence through the pituitary gland. An example of this is the pituitary hypertrophy in pregnancy, due to parenteral absorption of heterogeneous albumins, which may be to some extent of placental origin, because hypertrophy is experimentally produced also by injection of placental extract and of peptone. It is also produced by the injection of ovarian extracts. He likewise regards the anterior pituitary and the hypothalamus as intimately concerned in the mechanism of ovulation and as possessing a controlling importance in regard to menstruation, because he has observed suppression of ovulation in animals when the anterior pituitary lobe was removed, and its precipitation by injections of pituitary extracts. The climacteric symptoms after roentgen castration may be alleviated by irradiation of the hypophysis.

[10] There is a form of hypomenorrhea caused especially by insufficient development of the anterior uterine wall, with the resulting pronounced anteflexion. This deficient and unequal development of the organ is associated with changes in the mucosa, so that histological examination shows but a small number of glands in the menstrual stage.

entirely ruled out as a contributing factor in the production of the results.

SUMMARY

The results of this form of treatment lead to the conclusion that a certain dosage of radiation in carefully selected cases is capable of producing improvement in ovarian function, as shown by the regulation of menstruation and the induction of pregnancy, with the birth of healthy children.

There cannot be any objection to this form of treatment on grounds that the already diminished ovarian activity can still further be diminished by the small doses of radiation. If the condition of the ovary is such that this should actually take place, nothing is lost, for such an ovary is hopelessly incompetent to produce the menstrual mechanism, or to produce an ovum capable of fecundation.

ANALYSIS OF RESULTS

Total number of cases.....36

Ages		
16 to 20	1	
21 to 25	10	26
26 to 30	16	
31 to 35	6	
36 to 40	3	
Total	36	

Successful Cases

Total number of cases.....22

Regular menstruation—no pregnancy 15
Regular menstruation—pregnancy 7

Ages	Cases
21	2
22	1
24	2
25	1
26	4
27	2
28	2
29	1
30	2
34	1
35	1
37	1

Ages	Cases	
16 to 20	0	
21 to 25	6	19
26 to 30	13	
31 to 35	2	
36 to 40	1	
Total	22	

Case No.	Age	Para	Interval between last menstruation and treatment	Interval between treatment and result	Comment
1.	21	0	9 months	5 weeks	Regular. Reduction in weight.
2.	27	0	8 "	10 "	Regular for 8 months. *Pregnancy;* normal birth.
4.	24	0	4 "	4 "	Amenorrhea for 18 months prior to marriage. Regular for 10 months. *Pregnancy.*
6.	21	1	4 "	4 "	Regular for 2 months. *Pregnancy.*
12.	34	1	17 "	4 "	Regular. Weight 220 pounds. Reduction.
11.	30	0	3 "	8 "	Regular. Profuse.
15.	27	0	4 "	4 "	Regular. *Pregnancy;* premature birth.
16.	35	0	8 "	16 "	Regular. Two series—last 50 per cent.
17.	30	2	3 "	4 "	Regular. *Pregnancy;* birth normal.
18.	26	0	6 "	4 "	Regular.
20.	29	0	5 "	4 "	Regular.
21.	30	0	36 "	7 "	Regular but scanty.
22.	28	0	18 "	4 "	Regular.

(Continued from previous page)

24.	28	0	24 "		4 "	Regular.
25.	26	0	5 "		4 "	Regular. *Pregnancy* (unterminated).
26.	37	0	72 "		4 "	Regular; 5 days for one period.
27.	22	0	6 "		7 "	Regular.
29.	26	2	1 "	(1-day menses)	3 "	Regular; 3 days.
32.	25	0	2 "	(4-month menses)	2 "	Regular.
33.	24	0	7 "		7 "	Regular. Reduced weight 47 pounds.
35.	26	0	7 "		7 "	Regular. *Pregnancy* (unterminated).
36.	30	0	1 " (previous interval 7 mos.)		4 "	Regular.

Pregnancies

Total number of cases 7

In primipara 5
In para-I 1
In para-II 1
Total 7

Premature birth ..... 1 (due to nephritis).
Normal termination 4
Unterminated 2

Case No.	Age	Married (years)	Para	Interval between last menstruation and treatment	Interval between irradiation and result	Notes
2.	27	5	0	8 months	10 weeks	Menstruation for 8 months. Pregnancy. Normal birth.
4.	24	4	0	4 "	4 "	Had ceased for 18 months prior to marriage. Pregnant after ten menstruation periods. Normal birth.
6.	21	3	1	4 "	4 "	Pregnant after two menstruation periods. Normal birth.
15.	27	5	0	4 "	4 "	Pregnant after three menstruation periods. Premature infant; nephritis. Sept., 1925, pregnant again.
17.	30	8	2 (stillbirth)	3 "	4 "	Pregnant after two normal menstruation periods. Normal birth.
25.	26	7/12	0	5 "	4 "	Pregnant after seven normal menstruation periods. Now pregnant.
35.	26	5	0	7 "	7 "	Pregnant after twelve normal menstruation periods. Now pregnant.

Failures

Case No.	Age	Para	History	Remarks
3.	36	2	Menses irregular; three times in five years.	Failure due to age. Probably premature menopause.
5.	21	0	None for three months.	Insufficient treatment Inflammatory process in pelvis.
7.	27	0	Always irregular. Last menses eighteen months previous.	Atrophic cystic degeneration of the ovaries.
8.	24	0	Once, at six. Once, at sixteen. Stained once, four months after marriage. Had flushes for some time. Sexual anesthesia.	Congenital ovarian deficiency. Uterus small and retroverted. Left ovary not palpable. Tried diathermy.
9.	29	0	Always irregular, becoming increasingly so.	Amenorrhea 1 year.
10.	36	0	Twelve times in last eighteen years. Had flushes some time ago. Last menstruation six years before treatment.	Ovaries not palpable. Dark skin. Hypertrichosis. Defective development of generative organs.
13.	31	1	Always irregular. Last menstruation eight months before treatment.	Cause of failure unknown.
14.	26	0	Always irregular. Last menstruation eleven months previous.	Congenital ovarian deficiency.
19.	18	0	Always irregular. Last menstruation nine months previous.	Congenital retroversion.
23.	30	0	Stained for last seven years, with pain.	No change; same as before treatment. Infection following miscarriage seven years previous.
28.	22	0	Irregular for sixteen months. Fibroid uterus.	Cramps. No result. Cause: Probable beginning fibrosis.
30.	23	0	For sterility. Menstruation regular.	Small hypoplastic uterus. Sexual anesthesia.
31.	23	0	Always irregular. Last menstruation five months previous.	Probably cyst of ovary.
34.	31	0	For sterility. Menstruation scanty,—one day.	Menstruation returned, 4 days' duration, normal amount. Sterility unchanged.

Total number of failures..... 14

Ages	Cases	
16 to 20	1	
21 to 25	5	9
26 to 30	4	
31 to 35	2	
35 to 40	2	
Total	14	

Failures due to premature menopause (?)..... 2 cases
(Case 3, age 36; Case 10, age 36.)

Failures due to congenital deficiency or genital tract development ..... 6 cases
(Cases 7, 8, 9, 14, 19, and 31.)

Failure due to unknown cause..... 1 case
(Case 13, age 31.)

Unsuitable for treatment..... 3 cases
(Case 5, pelvic infection; Case 23, pelvic infection; Case 28, incipient fibrosis.)

Sterility ..... 2 cases
(Case 30, undeveloped uterus; Case 34, menstruation returned to normal. No pregnancy.)

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DISCUSSION

DR. H. J. ULLMANN (Santa Barbara): I did not know that this paper was to be given this morning and I heard only the last half of it, but I think we have not done enough on the non-inhibiting dose of radiation. We are getting away from the idea that small doses stimulate cancer. Note that I say a small dose; there are stimulating doses. I believe that the true stimulating dose is infinitesimal compared to our average dose. The reason for this is that I have been making some growth experiments with rats and have found that the line separating a dose that would inhibit their growth and a dose that would stimulate was very narrow and that the stimulating dose was extremely small, approximately 1/380 of the 1,300 *e* or 100 per cent dose discussed this morning, and that dose must be given as a rule not oftener than twice a week. This is preliminary work, and it will be a year or two before it will be ready for publication because it must be carried through several generations. We can offer the following clinical experience of this fine line between a stimulating and an inhibiting dose: Following the report that radiation of the hypophysis would benefit the hot flashes of the climacteric period, I tried it on an individual who was being wakened fourteen to fifteen times a night by these flashes. She kept an accurate record of these by our request. An exposure of three minutes with our usual standard factors of 50 cm. distance, one millimeter of copper and one millimeter of aluminum, gave marked relief, cut the number of flashes in half. A week later she received another dose, with benefit. Then, as the German author suggested that it was an inhibition, I thought perhaps a slight increase in dosage would benefit her still more. I increased it to about seven minutes, a little more than double, and her hot flashes came back as bad or worse than when we started. I gave her a ten-day rest, then went back to the three-minute dose and produced relief again. We must realize that if we use infinitesimal doses we may be able to get a true stimulation. The field for investigation there is wide open.

DR. W. L. ROSS (Omaha): I wish to ask the author what his experience has been in the dose necessary to produce permanent X-ray castration.

DR. HIRSCH (closing): In reply to Dr. Ross, I would say that roentgen castration is a procedure that is many years old and can be produced by small doses and by large doses, depending on the patient. My impression is that in the average cases the doses utilized to produce roentgen castration are too large; provided you are willing to wait a couple of menstrual cycles you can get roentgen castration with a small dose, but when it becomes important to produce castration immediately—as when a woman is bleeding very severely or the fibroid is producing a great deal of pressure—the large dose may be necessary. On the whole, my feeling is, particularly since the advent of deep therapy, that we are using too large doses to produce castration.

IMPORTANT CONSIDERATIONS IN PLANNING AN X-RAY DEPARTMENT[1]

By P. M. HICKEY, A.B., M.D., Ann Arbor, Michigan

IN planning a new X-ray department, the roentgenologist, who will be in charge, should submit to the designing architect the preliminary layout, with a comprehensive list of the details to be included.

The problem should be approached with especial thought and consideration for all the factors which will develop efficiency in the department. Thought must be given to the size of the department, its place in relation to the other units, and the arrangement of its sub-departments.

In planning the amount of floor space needed, the bed capacity of the hospital must be considered, the size of the out-patient department, the problem of teaching, and the problem of future expansion. If the service in the hospital shows a rapid turnover, it follows that this factor must be taken into consideration in planning the size of the department. If the hospital is a teaching institution, the rooms must be made somewhat larger for the accommodation of sections of students and extra rooms should be added for section teaching. If sections of students are to be shown fluoroscopic work, the fluoroscopic room must be proportionately enlarged. If there is an active out-patient department attached to the hospital, a careful survey should be made as to the probable number of out-patient cases, so as to provide proper waiting room space and extra dressing rooms.

A careful study should be made of all the factors which will govern the growth of the institution, so that proper provisions may be made for possible future expansion. As nearly as possible, units of construction should be followed, so that sub-departments can be shifted if the growth of the department demands, or if the character of the work should change. Generally, one should avoid planning rooms with permanent partitions which will prevent changes in size and arrangement.

In planning the rooms for the separate sub-departments, a careful study of the problem should be made from the efficiency standpoint. In other words, the arrangement of the rooms should permit that the work be accomplished with the least amount of physical fatigue to the personnel. The radiographic department should group the exposure rooms about, and as close to, the developing room as possible.

In these days of heavy cassettes, the necessary travel of the cassettes should be made as short as possible. As many of the exposure rooms as possible should communicate directly with the developing room by simple wall cupboards with light-proof and automatically locking doors. These cupboards should be provided with a partition separating the in-going cassettes from the out-coming cassettes. The adoption of the arrangement just suggested will minimize the fatigue of the personnel at the end of a busy day.

In a well equipped exposure room with rapid machines and convenient tables, it follows that the amount of work which can be turned out will be directly proportional to the number of adjacent dressing rooms. Nothing slows up the efficient turnover of a department as much as an insufficient number of dressing rooms. The size of the waiting rooms can be diminished if there is a proportionate increase in the number of dressing rooms.

The most efficient type of dressing room is the one which is placed between the reception room and the exposure room, each room provided with a door opening from the reception room into the dressing room and a door on the other side of the dressing room opening directly into the exposure room. With such an arrangement, patients pass directly into the dressing rooms and then on into the exposure room without

[1] Read before the Radiological Society of North America, at Cleveland, Dec., 1925.

parading, attired only in gowns, through the corridors; this plan also prevents patients from being lost sight of. Doors opening from the dressing rooms into the exposure room need not be full length, an arrangement which will allow the technician to know the number of patients waiting in the dressing rooms.

In a department where gastro-intestinal examinations are made, the number of dressing rooms should be ample, the number depending to some extent upon whether the single or double meal is employed. We will repeat that there is nothing which economizes time as much as an adequate number of dressing rooms.

The first sub-division of the department should separate the rooms where the actual examination and treatment of patients are carried out from the group of rooms which can best be designated as service rooms, where the clerical help and staff are engaged in the preparation of reports, together with the filing and indexing of films. By maintaining these two general sub-divisions, the segregation of patients will be accomplished and the visits of the hospital staff expedited.

Special attention should be given to the rooms where fluoroscopic examinations are to be made. This work should be carried on in rooms of ample size, adequately ventilated, with properly designed electric fixtures for indirect illumination. Fluoroscopic rooms should never contain steam pipes other than those directly connected with the radiators within the room; neither should hot water pipes be allowed within the room. Unless this precaution is taken, it will be very difficult to regulate the temperature within these rooms, even if the heating system is provided with thermostatic control. These rooms should be provided with generous window space, so that when the actual work of the examination is not in progress, the rooms can be exposed to daylight and fresh air. The windows should be provided with rapid and efficient means of excluding daylight. Curtains and flimsy window shades should never be employed for this purpose. Close fitting window shutters of well seasoned wood, with wide overlapping joints, are very essential. The architect should be provided with the design of a correct type of window shutter, one that has proven to be light-tight under the wear and tear of daily usage.

The problem of ventilation is very important. Ample blowers, which will deliver a good supply of fresh, cool air from the outside, are indispensable. The rooms should be provided, also, with electric fans for agitation of air. The general ventilating system of the hospital cannot be relied upon to furnish the necessary amount of fresh air for efficient work of the personnel, when working in light-tight rooms.

If possible, separate rooms should be provided for gastro-intestinal work, pulmonary fluoroscopy, and surgical fluoroscopy. Every chest should be carefully fluoroscoped before films are made. This routine will minimize the number of return examinations in respiratory cases and will result in a saving of the number of films used.

The room for surgical fluoroscopy should be provided with a plaster sink, so that the surgical personnel may have a place to clean up after putting on plaster casts without danger of obstructing the drain pipes.

Considerable study should be devoted to the question of indirect illumination of the fluoroscopic room. Fixtures should be designed of a type to make use of indirect illumination only, both for the white and for the colored lights. Lighting engineers have not yet concerned themselves with the proper illumination of these work rooms. Numerous base plugs should be installed for the use of the dictaphone and movable lights. These wall fixtures should be arranged so that easy control of the indirect illumination may be had. The eyes of the personnel should always be protected from direct illumination. The doors of the fluoroscopic room should be provided with a light trap, unless the openings communicate with corridors where the illumination can be diminished if necessary.

A plan which may be followed in out-

lining the details of an X-ray department is to carefully visualize the complete details of all the various types of examinations and work which will be done. If careful consideration is given to how each examination is to be made and what is necessary for the examination, the placing of equipment will be worked out to better advantage. This includes the location of washstands, base plugs, wall switches, ceiling lights, closets, cupboards, and conveniences for clerical records. Only by repeated visualization of the anticipated work will the omission of details be safeguarded against.

In planning the developing room, one must consider, first of all, the question of ample window space, ventilation, and adequate plumbing. At least one window of generous size should be insisted upon, so that as frequently as possible daylight may be admitted. The best safeguard for a clean dark room is to admit a generous amount of daylight at frequent intervals. The dark room should preferably be divided into two parts, (1) the room where films and screens are kept, and (2) a second room where the developing is actually done. This division is a measure which helps to preserve screens and cassettes. This room should be provided with an ample amount of space so that the loading and unloading of cassettes can be accomplished with a minimum of damage. It also minimizes floating particles of dry hypo. The room where the actual developing is done should have a cement drain in the floor over which the developing tanks can be located. This will take care of overflow and also the drippings from the developing rack.

The question of floors in the department is of vital importance. From the standpoint of safety, a wooden floor has many advantages. A plain concrete floor should not be used in rooms where high tension currents are employed. A cork floor, covered with battleship linoleum, should be selected if it is not possible to obtain a wooden floor. In dark rooms, switches near the tanks should be carefully insulated so as to prevent the possibility of electric shock. Several bad accidents have been reported in cases where the technician has had one hand in the solution while the other came in contact with an uninsulated switch.

In planning the electrical power supply, the X-ray department should have a separate outside transformer with an individual service to the various outlets in the department. Under no circumstances should the X-ray department derive its power current from transformers which also supply current for other power plants within the hospital. The efficiency of many a department has been ruined by having its power circuit on the same line with electric elevators. The conduit from the outside transformer to various outlets in the exposure rooms should be of a generous enough size to allow of at least 00, or preferably 0000 wire. This detail is one which is often not appreciated by electrical engineers, unless they have had wide experience. Many well designed X-ray machines have had their efficiency greatly impaired by being fed by too small feed wires. The fuse boxes for both the power and lighting circuits should be conveniently located, so that fuses can be replaced with a minimum of time. In designing the wiring in the demonstration room, the electrical engineers should be instructed carefully as to the maximum load of illuminating boxes, stereoscopes, etc. Ample base plugs should be provided so as to permit of a rearrangement of the illuminating boxes, if desired. The windows in the demonstration room should be provided with dark curtains so that the quantity of daylight admitted can be under easy control. In the demonstration room, part of the outlets for illuminating boxes should be in the ceiling, so that a ceiling connection can be made if so desired.

In small hospitals where the architect is desirous of saving floor space, the X-ray department is frequently placed in the basement, a most undesirable location. The writer recently saw a small well equipped hospital where the design had been drawn

by a hospital architect in consultation with a well known consulting hospital superintendent, who drew a salary of one hundred dollars a day, with expenses. With their combined talents, they located the X-ray department next to the furnace room in the basement, ventilated by one small window, over which a radiator was suspended in such a fashion that the room could not be darkened for fluoroscopic work. The dark room was truly well named, inasmuch as it did not have a single window, the only ventilation possible being through the door. The electrical conduit, leading to the X-ray room, admitted only of a No. 4 wire.

It has been the custom in some departments to use considerable lead in the walls to prevent radiation going from one room to another. The writer believes that it is much better to surround the tube with efficient X-ray opaque material and to rely for further protection upon barium plaster walls and barium plaster floors. A layer of barium plaster cement on the floor with a covering of cork and linoleum will efficiently protect radiation from penetrating to the rooms below. The use of barium cement tiles in the walls or partitions is a further aid in protection.

The planning of a room for film storage will have, of course, to be governed by the local fire regulations.

In planning for efficiency in dark room work, it is highly desirable to install conveniences for the rapid drying of films. This dryer will be more conveniently located if it is placed in the wall of the dark room, with small doors opening into the corridor. This will allow the removal of films from the dryer without the filing clerk having to enter the dark room.

The location of a toilet off of the gastric room is important. The opening should never be directly into the gastric room, but should be conveniently placed in connection with the dressing rooms. One of the dressing rooms in the gastric department should be made of sufficient size to admit a couch which can be used either for patients who may be very much fatigued or for the giving of a cleansing enema preparatory to the barium enema.

If possible, a small waiting room should be planned in addition to the large waiting room. An additional small waiting room is most convenient and can be used by those patients who obviously should not be placed in the general waiting room.

In the general plan of a new hospital, base plugs should be placed about the wards and in the private rooms for the use of portable X-ray machines. These plugs should be capable of carrying a current of at least thirty amperes and should be fused accordingly.

CONCLUSIONS

In general, the planning of an X-ray department presents problems which are often peculiar to the type of institution where it is to function. While general conclusions can often be drawn and general plans followed to advantage, yet each department demands the most careful study: (1) to realize the general scope of the problem, and (2) to work out the various details with the utmost care. The more one can visualize the problem and visualize the working out of the problem, the better will be the finished result.

DISCUSSION

DR. ALBERT SOILAND (Los Angeles): Perhaps no man in America is better fitted to tell us how to construct the X-ray department of an office or hospital than Dr. Hickey, and I am sure many of us would not even dare to add anything to what he has said on this subject. He has covered nearly every point I can think of in line with this discussion. I have just designed an X-ray department for a hospital which is to be built in the city of Riverside, California, which carries out some of these ideas, if I may be permitted to show these two slides. These, however, consider only the therapeutic aspect, but the art of protection and insulation is in full accord with Dr. Hickey's remarks. This is similar to my own private installation for X-ray ther-

apy, only, in this instance, I have doubled the capacity and placed the machinery in the middle of the house, surrounded by the operating chambers. The building is solid concrete and will have barium plaster walls and all the excess radiation possible will be stopped at the source. The machine room is large and airy and will carry the high lines in the middle of the chamber to the operating laterals. Ventilation is obtained through a continuous line into the open air. The treatment booths are ventilated through a separate passage into the open air. The patients' dressing rooms and treatment rooms are immediately opposite each other. The operators' control boards are protected on all sides against the treatment booths. The ground floor of the machine room has been laid out for future clinical purposes. The slide shows a cross-section of the operating department of this institution. Here we have the chief of department: his desk is placed so that he can look through a large leaded glass window down this battery line of transmission into the different treatment booths. He can see at a glance just what is going on. Even the switches and meters, if so desired, may be viewed by means of mirrors. The operating hall is shown, with the control cabinets. Each operator has two treatment booths to take care of. It is aimed to have six high voltage installations on one side of the battery and six moderate voltage on the other side. We believe this is an advanced construction and practical, and hope it will conform to everything Dr. Hickey has suggested in his paper.

DR. HICKEY (closing): I just want to emphasize one thought which an architect gave me once, and which I have found very valuable in working out details. Take a pencil and paper and visualize the work of one day: if you are going to work in one room and want a particular light, for example, jot it down; if you are going to use a dictaphone, give the electrical engineer specific directions as to where the base plug is to be placed. Visualize in your mind as far as possible every little detail of the things you have to do every day. It is only by following out such a scheme that you will not omit details.

Unusual articulation in the heel.—This is a case report, accompanied by a roentgenogram taken to exclude a fracture after the patient had sustained a severe contusion of the foot. No fracture was found, but the unique condition of an extreme projection from the posterior surface of the astragalus, with a separate joint for this projection on a corresponding projection of the os calcis. The anatomic department of Cornell University had no record of a similar finding. Many cases of lipping of the posterior edge of the astragalus are seen, and, rarely, a case of an extratarsal bone; the surgical significance of these unusual findings is obvious.

Unusual Articulation of the Astragalus and the Os Calcis. Charles E. Farr. Jour. Am. Med. Assn., April 10, 1926, p. 1128.

Light reflection and absorption by the skin.—A very important question in light therapy is the ratio between absorption and reflection in the skin. The author points out that the rays of the visible spectrum (7,250–4,000 A.U.) striking the skin, may be reflected, absorbed, and transmitted. He develops a method which consists in the comparison of the spectrum reflected from the skin with the spectrum of an artificial light source of known but variable intensity, reflected by a magnesium oxide surface. It appears that unpigmented skin which has almost never been exposed to light, reflects a high percentage of the spectrum, while pigmented skin reflects much less, and absorbs, therefore, a greater amount of radiation.

E. A. POHLE, M.D.

On Reflection and Absorption of the Skin in the Visible Spectrum. W. Schultze. Strahlentherapie, 1926, XXII, 38.

EVALUATION OF STIMULATIVE ROENTGEN THERAPY IN CERTAIN SURGICAL AND NEURO-CIRCULATORY DISEASES

By HERMAN B. PHILIPS, M.D., New York City

DURING the past five years, the author has had the opportunity of investigating the value of roentgen-ray therapy in various orthopedic and allied surgical conditions. Approximately three hundred cases have been treated, privately and in a large orthopedic hospital, during this time. The treatments were with so-called "stimulating doses." Many of the cases were observed over a few years' time, others were lost track of as soon as the results sought after had been secured, and in other instances, treatments were abandoned as unsuccessful. The object of this communication is a critical evaluation of this form of therapy, after further experience and observation of this method since the original publications of the author on these subjects, also to review, very briefly, work of a similar character, both abroad and in the United States.

The existence of a stimulating X-ray dose has been denied by some writers, notably Holzknecht, Kienboeck and Porges (1). This view is opposed by Loeb, Frankel (2), Lintz, Albers-Schoenberg, E. Seizfell, Knox and others. Anyone who has had any experience with roentgen rays must admit the stimulation of metabolic processes by small X-ray doses, with an improvement in the metabolic disturbances and inflammatory conditions, as a result of small, oft-repeated doses of radiation. The author feels that to decry the use of the term "stimulating dose" is to quibble over useless and purposeless discriminations. The fact of the matter remains that however the tissues react, whether to direct stimulation of metabolism or by a reaction to a slight destructive process, the effect is undeniably one of stimulation. Personally, the writer is inclined to feel with Loeb (3), that, "Light doses stimulate, medium doses depress and heavy doses of X-ray destroy tissue."

In a communication published conjointly with Dr. Harry Finkelstein (4), in 1922, I called attention to the value of stimulative X-ray therapy in chronic diseases of bones, joints and tendons. A prophecy was made at that time that the X-ray would find a high place in the therapeutic armamentarium of the orthopedist because of its curative powers. My feeling on this matter now is even more intense than at that time, and I feel that ultimately the X-ray will occupy almost as important a place in the treatment of orthopedic conditions as it does now with the dermatologist, in the treatment of skin conditions. The field of usefulness of roentgen-ray therapy has enlarged constantly, so that to-day its scope includes many of the ailments of mankind. Its wide use in dermatology is common knowledge. Its application to infections of various types became known during the war, and it is now used consistently in many medical centers. Every year brings forth some new application of X-ray therapy. The subject is too extensive to permit one to make mention of all the work that has been done and the various applications of roentgen-ray therapy. However, as complete a list as is available at this time is included in the bibliography (5).

The cases treated are divided into the following groups:

1. Tubercular arthritis and osteomyelitis.
2. Chronic pyogenic osteomyelitis.
3. Chronic arthritis and chronic synovitis.
4. Teno-synovitis (ganglia).
5. Anterior poliomyelitis.
6. Neuritis.
7. Thrombo angiitis obliterans.
8. Stimulation of bony callus formation in ununited fractures.

1. Tubercular arthritis and osteomyelitis. The results secured in this condition are very gratifying and were summarized, in our original contribution (4) on this subject, as follows: "Roentgen-ray therapy is available as probably the greatest, but least used, therapeutic agent in the orthopedist's armamentarium." "Night cries, muscle spasm, uncontrollable pain, temperature and malaise frequently disappear after a few radiations. Chronic sinuses dry up and become obliterated."

It was also stated at that time that "Orthopedic and surgical measures are aided but not replaced by X-ray therapy." Braces, casts and the like should not be discontinued during the treatments until definite cures have been established.

Since the publication of this article, numerous others have appeared extolling the value of this form of treatment of surgical tuberculosis. Holfelder (6) in Salzmann's "Roentgen-ray Therapy," in 1923, called attention to the value of this form of treatment. He recommends, as in the rest of his work, "the use of homogeneous radiation" and also emphasizes "the necessity for the observance of usual orthopedic measures."

Southard (7), in July, 1925, reported 81 per cent cures of over one year duration of bone and joint tuberculosis, and stated further, "In spinal tuberculosis in both children and adults the results have been particularly gratifying, because, in the five cases treated, no rest measures were used." In some instances of considerable bone destruction, Southard observed the bone defects entirely to fill up by bone regeneration during the treatment. He concludes from his observations that the X-ray offers a safe, sane, and effective method of treatment of a most intractable disease. Desplats (8), in 1924, commented most favorably on the usefulness of X-ray therapy in tuberculous osteitis and published some illustrations showing the favorable progress of the lesions under treatment. Haas (9), in 1924, called attention to the value and effectiveness of the combination of the roentgen ray with surgical and orthopedic measures. Petersen and Hellmann (10), in 1924, after an analysis of 669 cases of surgical tuberculosis treated with X-ray, concluded that the X-rays can be used as an adjuvant in the treatment of these conditions and that their use in small doses is imperative. Newcomer and Conyers (11), in an article on the present status of X-ray therapy, report a case of tuberculosis of the hip and spine, with pronounced improvement after a few treatments, and the closure of a chronic tuberculous sinus. Altschul (12), in 1925, reported very favorable results obtainable in bone and joint tuberculosis when combined with orthopedic measures. That there is a firmly established experimental basis for the results just described is attested to by Kessel and Sittenfield (13), who, in 1914, investigated the effect of penetrating rays upon experimental tuberculosis and concluded that guinea pigs inoculated with tuberculosis live longer if exposed to X-rays, that caseation is less evident in tuberculous lesions in rayed animals and that fibrosis about the individual tubercles is more marked in radiated animals.

2. Chronic pyogenic osteomyelitis. The results secured in this condition are very similar to those obtained in treatment of tuberculous arthritis and osteomyelitis. Our conclusions, published in 1921 (4), on the treatment of chronic osteomyelitis were that "sequestration is favored by X-ray radiation, the chronicity of osteomyelitis is markedly shortened and drainage by radiation of deep-seated abscesses is favored. Chronic sinuses dry up and become obliterated." Knox (14), in his standard textbook on radiotherapy published in 1918, stated that a "useful field exists in the treatment of chronic septic wounds where the judicious employment of radiation treatment, in one or other of its forms, will lead to the attainment of satisfactory results, which may be far in advance of any obtained by better known and more widely

used methods of the day." During 1924, at a meeting of the orthopedic section of the New York Academy of Medicine, Dr. Lenz presented some cases showing the strikingly beneficial effects of X-ray treatment of sinuses from chronic osteomyelitis. My personal results since the original communication in 1921 (4) have been to confirm the original conclusions, with a few additional observations. If the osteomyelitis is not too extensive the stimulative effects of the radiation will produce a cure of the condition. A failure to secure results must be explained on the basis of too extensive involvement. A small sequestrum will pass through a sinus after radiation. However, a large sequestrum will not disintegrate sufficiently to pass through the sinus, and has to be removed surgically. A chronic osteomyelitis with low virulence, neither retrogressing nor advancing, will be brought to a head with a sinus pointing, after a few exposures, with possible exfoliation and discharge of the sequestrum. X-ray therapy is not recommended in an acute osteomyelitis, where surgery must be resorted to without delay.

3. Chronic arthritis and chronic synovitis. Chronic arthritis and synovitis respond to irradiation, frequently with complete disappearance of all symptoms. However, the results are not uniform and some instances have been recorded of complete failure to relieve the symptoms. The treatment of this type of infection was also undertaken and reported on in a very comprehensive and classical article by Pfender (15), of Washington, who recommended roentgen-ray therapy, particularly for spondylitis deformans of the spine. Personally, I have been able to secure relief, many times, of pain in cases of multiple arthritis of the small and large joints, in otherwise intractable cases. I do not propose to recommend this as the sole method of treatment in infectious arthritis—it is to supplement the usual methods of treatment. Numerous instances are on record of polyarthritis of the hands, wrists, elbows, etc., which have responded to X-ray therapy after complete failure to respond to other methods. Relief of pain is a most pleasing and an early result. Appelrath (16) states that the disease is favorably influenced, with amelioration of pain and improvement of motion.

4. Teno-synovitis (ganglion). As far as can be determined, the author reported the first cases of ganglia treated with X-ray (4). Further experience with this condition permits a classification of ganglia, according to their response to radiation, into two types—the hard, dense, circumscribed type and the soft, diffuse type. The first type does not respond uniformly to radiation. I should place the successes at about 30 per cent. With the soft, diffuse type the results are more nearly uniform and highly gratifying. Cases have been observed over a few years without recurrence. When one considers the risks and frequent failures of surgery in this treatment, X-ray therapy should be the method of choice and surgery held in reserve, if X-ray fails. In one particular case of a hard ganglion, which was not responsive to X-ray, two 12.5 mgm. radium needles were inserted into the ganglion for one hour, resulting in a complete cure, after two years' observation.

5. Anterior poliomyelitis. Investigation of the use of X-ray therapy in this condition was undertaken in conjunction with Dr. Walter I. Galland (17) in 1923. Since the original series, it has been used on a few cases, with an opportunity of confirming the original findings. Relief of the hyperesthesia was an almost uniform and immediate result. Improvement in the circulatory and trophic conditions of the limb was obtained uniformly. However, improvement in paralysis, especially of long standing, was not uniform, and in one case no changes whatsoever in the paralysis were recorded.

Of late, there have been numerous reports of similar applications of X-ray therapy to the treatment of poliomyelitis. A

good many of these authors use diathermy in conjunction with X-ray. We were inclined to feel that the best results would be obtained if the treatments were started very early, and this is corroborated by other writers. Most of the work on poliomyelitis has been done by the French investigators. Bordier (18), in 1925, claimed that the treatment of infantile paralysis had been attended by very favorable results in the hands of certain roentgenologists. The failures he attributed to the improper focusing of the rays and to inadequate penetration. Mario Berjamini (19) quotes and confirms Bordier and recommends starting the treatments as soon as possible. Similar favorable results have been published by Terano (20). He feels that there is no better method of treatment known, if the treatment is applied early. J. Comby (21) treated his patients with X-ray, supplemented by diathermy, and reported in a series of 14 cases, 4 very good results, 8 good results, and 2 fair results. He also emphasized the value of early treatments, preferably within twenty-four to thirty hours after the onset.

6. Neuritis. The author has treated several cases of neuritis with good results. The explanation of the phenomena of relief is difficult, and will not be attempted other than to express the feeling that the stimulation of metabolic processes in the nerves and in the intimately associated structures, gives relief of the symptoms. Some severe sciaticas and other neuritic conditions in other locations have been treated with almost complete relief of symptoms in a short time. These results were not uniform, and a few failures were encountered.

7. Thrombo-angiitis obliterans. The treatment of thrombo-angiitis obliterans was undertaken a short time ago in conjunction with Dr. Tunick (22), who made and recorded the clinical observations. After further personal experience with twelve private cases, my opinion is unchanged, that the X-ray offers a better method of ameliorating the symptoms of thrombo-angiitis obliterans than any other known. All of these cases had been treated previously with the usual forms of treatment. Some had sympathectomies, without success. A check-up, three months after the original report, on a series of 50 cases, showed that of 28 patients who responded to the request to come for a periodic examination, 20 were entirely free from symptoms attributable to the disease. Most of them had returned to work, suffering no incapacity whatsoever. Some of them had had complete relief of all symptoms for over a year's time. Most of the eight failures were of the senile arterio-sclerotic type, which are included with the original series. No results have been secured in the treatment of diabetic gangrene in the two cases treated, one privately and one in the clinic, so that the treatment is not advocated for diabetic gangrene. Several of the senile cases were distinctly benefited and I feel that the treatment should be given at least a trial in such conditions. Another examination of these patients three months later, when 20 responded to the request to come for physical examination, showed 19 to be fully restored to working capacity and with no subjective symptoms whatsoever, of any character attributable to the thrombo-angiitis condition. One, a diabetic, was found to be unimproved. The results secured according to our original conclusions (22) and substantiated by subsequent personal observations and treatment of other cases, may be again summarized as follows: "That the X-ray improves the condition of the circulation and the trophic disturbances in the extremities; that the pain is suppressed, with few exceptions; that ulcers heal comparatively rapidly, and the condition as a whole responds very favorably to radiation." It must be repeated that the radiation is not given locally, but over the spinal segments controlling the extremity. Vanysk (23) reports fair results from the treatment of obliterating endarteritis with subcutaneous injec-

tions of radium emanation. The original article is unfortunately not available and I regret that I cannot add the details of this investigator's contribution.

8. Stimulation of Bony Callus Formation in Ununited Fractures. I long ago demonstrated to my own satisfaction the value of X-ray therapy in stimulating callus formation in ununited fractures. One case history, in particular, is cited, along with illustrations demonstrating absolutely the value of this method of treatment.

A boy, nine years of age, sustained almost symmetrical fractures of both tibiæ and fibulæ. One leg was radiated and the other was not, and it was found that the radiated leg presented definite evidences of bony callus formation fully one week before the unradiated leg. The positions of the fragments in both legs were almost identical, so that this case may be considered a check on the results of radiation in the stimulation of bony callus formation in ununited fractures. Pohle (24) reports fifteen cases of delayed union in fractures stimulated by X-ray and feels impelled by his observations to draw the attention of the profession to the therapeutic value of this method of healing fractures. Considerable work of this character has been done consistently in Europe, and reports by Cluzet and Dubreuil, Wiesner, Frankel, Lehmann, and Tamann (25) and others prove conclusively the value of this method of treatment. W. G. Stern (26), discussing a paper on ununited fractures by Henderson, quoted a case of delayed union which came to firm bony union after three X-ray exposures.

For details of technic the reader is referred to the original contributions included in the bibliography. In a general way, stimulating doses were given, fractionally, over prolonged periods of time, with cross-fire technic. More specifically, the factors used in the treatment of surgical tuberculosis and pyogenic osteomyelitis were, 100 K.V., 5 mm. aluminum, 5 milliamperes, 15-inch distance, 10-minute exposures, alternating on different aspects of the diseased part, at weekly intervals. In deep-seated foci of infection the penetration of the rays was increased to 140 or 160 K.V., with corresponding increase in the filters and time.

Caution is advised in the treatment of tuberculous spondylitis, where some truly remarkable results were secured. When treating the dorsal vertebræ, it is advisable to shield the lungs as much as possible and to confine the rays to the spine alone. In one instance, an unquestionable reaction, similar in many ways to a severe tuberculin reaction, occurred from exposure of a tuberculous lung. It is advisable, after four treatments have been given, to give a rest period of a few weeks, and then resume the treatments at greater intervals until the clinical manifestations of the disease show definite improvement. Treatments should be suspended or diminished as soon as a favorable response is noticed, thus avoiding over-dosage.

Cross-fire radiation with 100 K.V., 5 mm. aluminum filter, was used for ganglia and teno-synovitis. Sub-erythema doses were given over both aspects of the part and repeated two or three times at intervals of four or six weeks, thus avoiding pigmentation of the skin.

In chronic arthritis and synovitis the treatment is essentially the same, 100 K.V. being used for joints of the extremities and 160 K.V. for spinal or hip joints.

In infantile paralysis, 100 K.V., with the other factors described under osteomyelitis, was given at weekly intervals, alternating over the anterior and posterior aspects of the involved cord segments, for about four or six treatments and then a rest period of a month, and an occasional short series of treatments later. The cervical spine was radiated in upper extremity involvement with the same factors, but the X-rays were directed from each postero-lateral aspect, protecting the thyroid gland.

The treatment of neuritis is the same, and given over the origin of the plexus of nerves and over the course of the distribu-

tion of the nerves, with 100 K.V. ordinarily, and 160 K.V. when the parts are thick.

In thrombo-angiitis obliterans, the 100 K.V. technic was used over the lumbar spine, with 5 mm. aluminum, 5 milliamperes, 15-minute exposures, 15-inch distance, alternating front and back at weekly intervals. The technic in the last fifteen or twenty cases has been somewhat varied and the patients have been given mixed voltage, *i.e.*, two treatments with the above technic, then two with the 160 K.V., and ¼ mm. copper, one-half hour exposures and then going back to the aluminum filter and lesser voltage. A maximum of six treatments was given, then a rest period of a month, followed by a few treatments occasionally, as indicated, at monthly or six-week intervals.

To stimulate callus formation in ununited fractures, the same general technic as outlined above was utilized, the voltage depending upon the thickness of parts, but the intervals considerably shorter, the complete stimulating dose being given in a few days' time.

It has been my privilege in the past six years to investigate the value of X-ray therapy in various surgical and neuro-circulatory conditions and to note subsequently, with extreme gratification, my conclusions confirmed by reports of other investigators.

X-ray therapy is of proven value in the treatment of—

1. Surgical tuberculosis, supplementing orthopedic measures.
2. Pyogenic osteomyelitis, by favoring sequestration and closure of sinuses.
3. Teno-synovitis (ganglion), by reducing the size of the tumors, with frequent complete absorption.
4. Chronic arthritis and synovitis, ameliorating symptoms and lessening disability.
5. Infantile paralysis, by overcoming hyperesthesias and improving circulatory and trophic disturbances and improving paralysis.
6. Neuritis, by lessening pain.
7. Thrombo-angiitis obliterans, by improving circulatory and trophic disturbances, relieving pain, hastening healing of ulcers, etc.
8. Healing of ununited fractures by stimulating callus formation.

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24. Pohle, E. A.: Effects of X-rays on callus formation in ununited fractures. Radiology, July, 1925, p. 67.

25. Quoted by Pohle, E. A., *idem*.

26. Stern, W. G.: Discussion of M. S. Henderson's paper, Ununited fractures. Jour. Am. Med. Assn., Jan. 9, 1926, p. 85.

Roentgen-ray effect on single cell organisms.—Paramecium is very resistant to roentgen radiation even in high doses; in search of an explanation, the author decided to study the rôle of the surrounding medium, in particular its actual reaction (hydrogen-ion concentration). In neutral fluid (PH = 7.0) no effect of the radiation could be traced; changing the reaction by adding electrolytes ($MgCl_2$, NaCl, HCl) to the acid side, demonstrated for each electrolyte a definite PH which is fatal to the organism. Roentgen-ray exposure does not contribute to this effect at all. Shifting the PH to the alkali side by adding NaOH, Na_2CO_3, $NaHCO_3$, reveals also a concentration that kills all protozoa. Staying below the fatal PH (from 7.25 to 7.7 for the various chemicals), it is very interesting to note that the X-ray effect manifests itself; while the untreated controls live in these solutions, the treated cultures die off. It is deduced, from these observations, that the X-ray effect does not attack the cell directly but through the surrounding medium.

E. A. Pohle, M.D.

The Biological Effect of Roentgen Rays on Single Cell Organisms, Based on Experiments with Paramecium. E. Schneider. Strahlentherapie, 1926, XXII, 92.

Sun light and quartz light skin reactions.—Dorno, the well-known meteorologist, in Davos, Switzerland, presents the results of his investigations in regard to the differences in the erythema and pigmentation following sun and quartz light application. He finds that colored races show more pronounced reaction than persons with light skin. The erythema range of quartz light is much smaller (1:2) than that of the sun (1:4), compared on the basis of the minimum erythema doses. The skin reflection in unpigmented persons shows its maximum in red, its minimum in yellow; pigmented skin acts similarly. The total intensity of reflected radiation is, however, much smaller than in the case of untanned persons. The importance of the discussed problem for therapeutic questions is explained; it is suggested to measure the ultraviolet intensity with a cadmium cell, the sensitivity of which runs almost parallel to that of the skin.

E. A. Pohle, M.D.

Contributions to the Knowledge of Sun and Quartz Light Erythema. C. Dorno. Strahlentherapie, 1926, XXII, 70.

ROENTGENOLOGICAL EXAMINATION OF THE HEART [1]

By F. J. HODGES, M.D., Roentgenologist to St. Mary's Hospital, MADISON, WISCONSIN; Instructor in Roentgenology, University of Wisconsin

ALTHOUGH the roentgen study of the heart is by no means new, recent developments in apparatus and technic are worthy of consideration and may be of interest to this gathering. Tables of normal cardiac silhouette measurements have been developed at the University of Wisconsin, and though this work has been published elsewhere,[2] they may profitably be referred to here.

The area of the true frontal projection of the cardiac shadow, its transverse (and perhaps other) diameters, the proportionate length of the various sectors of the silhouette border cast by various portions of the heart are bits of information which can be used to great advantage by the cardiac diagnostician. After all, the physician percusses a heart to ascertain whether or not an hypertrophy or dilatation exists, and accuracy of observation here is as important as in the matter of temperature determinations. It is possible by a certain technic to measure the cardiac area very accurately indeed, and when carefully prepared normal tables are used for comparison (tables which take into account the factors which normally affect heart measurements), roentgen-ray studies will very quickly and accurately determine whether abnormal enlargement exists.

The special technic in question is the employment of steps to project the heart shadow with parallel rays in order to avoid distortion. This can be accomplished by teleoroentgenography or orthodiascopy, both of which methods are abundantly described in the literature. Of the two, the latter is the more valuable, for its use yields information as to the activity and mobility of the heart as well as to its physical measurements. Furthermore, under the fluoroscope the separate chambers of the heart may, in part, be identified positively and so measured. Orthodiascopy has the further advantage of being quicker and less expensive.

Several orthodiascopes have made their appearance and have fallen into disuse largely because they were cumbersome and afforded but poor protection for the operator. At the University of Wisconsin and in private practice in Madison several modifications have been tried out. All of these preserve the flexibility and safety of the ordinary modern fluoroscope and present the added advantage of permitting undistorted projection of a shadow on a screen for tracing. The most recent of these instruments was made for us by one of the companies manufacturing X-ray apparatus, and this instrument seems to afford excellent orthodiagraphic facilities with no limitation whatever of the ordinary usefulness of the fluoroscope.

The tables for normal cardiac area published by P. C. Hodges and J. A. E. Eyster[3] and those for normal transverse diameter by F. J. Hodges and Eyster[4] are based on the examination of a considerable number of presumably normal subjects of widely varying physical characteristics. Of this group, all cases showing accidental murmurs, extra ventricular systole, sinus arrhythmia, abnormal electrocardiogram, high pulse rate, and, in fact, any characteristic which might suggest slight or incipient cardiac disease were omitted in compiling figures. All cases were exhaustively examined and orthodiagraphic measurements were checked against seven-foot film

[1] Read before the Radiological Society of North America, at Cleveland, Dec., 1925.

[2] Bardeen, C. R.: Determination of size of heart by means of X-rays. Am. Jour. Anat., Phila., 1918, XXIII, 423-487.
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[4] Hodges, F. J., and Eyster, J. A. E.: Arch. Int. Med. (in press).

values. By mathematical correlation methods the effect of age, height and weight on area and transverse diameter were determined and final prediction formulæ were prepared in which these effects were proportionately evaluated. The mathematical procedure is given in detail in the paper by P. C. Hodges and J. A. E. Eyster.[5] The tables are so arranged that by adding the value for a given height to that for a given weight, the most probable normal measurement is readily obtained. The results compare closely with the widely used prediction tables for normal basal metabolism, and, although it is obvious that by this method the exact normal for an individual case can never be predicted, yet the prediction figure is infinitely better than random guess-work.

Since the compilation of these tables we have used them to excellent advantage in the examination of patients in whom heart disease is present or is suspected. Organic aortic lesions always show definitely increased measurements. In early uncompensated mitral stenosis enlargement does not occur. Normal cases never show great variation from predicted measurements. The advance of cardiac disease is paralleled by progressive X-ray findings. Stationary cardiac lesions may be checked with unchanging area determinations.

Dr. Eyster has recently completed a survey of a considerable group of clinical material which is soon to appear, in which the roentgenological findings for various heart lesions are tabulated, and his work demonstrates clearly the value of this method of examination.

Mitral stenosis is particularly striking in its X-ray signs. Frequently in its early stages when the pre-systolic murmur and thrill have not developed and always in its fully developed stage, mitral stenosis is characterized by an X-ray area of about normal size, an elongated and low-placed salient of the left border formed by the appendage of the enlarged left auricle and an obliteration of the upper portion of the retro-cardiac space seen laterally, due to the posterior enlargement of the left auricle. We have never seen this picture in the absence of proved mitral stenosis, although the roentgen findings have often been our first hint of the true state of affairs.

Casual fluoroscopic and radiographic observations of the heart are of little aid to the cardiac specialist in his work of appraising the circulatory status of a patient, and he has come to belittle the value of the roentgen ray in his field. By adapting our resources to his needs, however, we can offer him information, the accuracy of which surpasses many of the observations he is wont to employ, and we may, if we choose, be of valued assistance in this as in other specialized fields.

[5] See page 116, footnote 3.

DISCUSSION

DR. L. T. LEWALD (New York): I am extremely interested in the work of Dr. Hodges, and anything coming from Madison we all appreciate very much. Personally, I still attempt to measure hearts with relatively short exposures teleoroentgenographically, and believe that is a satisfactory method. I also reached the conclusion several years ago to abandon all other measurements in routine examinations except the heart silhouette and the transverse diameter.

DR. HODGES (closing): I am very glad that the subject of cardiac roentgenoscopy is receiving favorable comment. During the discussion one of the speakers brought up the matter of ultra-rapid exposures in the making of teleoroentgenograms. We have not sought to do this in clinical work because we desire to determine diastolic size, which is the phase upon which the normal tables are based, and to do this several cycles are necessary rather than a flash exposure which may fall at any point in the cardiac cycle. The splendid work presented by Dr. Ruggles last evening, his technic for making thirteen exposures during a

single heart cycle, does, of course, require extremely rapid exposures. That work is of great interest to us at Wisconsin University, for we have for several years been attempting to accomplish much the same thing. We feel that the future in this field is most alluring and that it will permit of almost unlimited exploitation in the production of valuable clinical information.

The dream which we have had—and which, in the light of Dr. Ruggles' work, seems just now to be somewhat nearer—is the perfection of a method of so timing exposures as to make possible the taking of teleoroentgenograms during the presphygmic period, when the heart is filled with blood and all valves are closed, and again at that stage of relaxation when the heart contains only residual blood and when again the valves are all closed. This would give true maximum size and true minimum size. This much has been done by Meek and Eyster, but only occasionally, and then by the method of trial and error. When we are able, by using the electrocardiogram for timing purposes, to get these phases at will it will be possible for the roentgenologist to supply the clinician with a cardiac function test the results of which bid fair to surpass his wildest dreams—a functional test which will give him in cold figures the minute volume of any heart he may desire to study and a test which may be applied during rest or exercise. It will furnish maximum and minimum heart size films in the same heart cycle, with each exposure indicated on the electrocardiogram as well as the exact heart rate.

Carcinoma of the colon.—The greater portion of this article is devoted to the technic used and advised in the surgical treatment of carcinoma of the colon. The authors seem to believe that the increase in cancer is partly due to the results of medical science in increasing man's longevity. The need for a blood test for detection of early cancer is stressed, and the prophecy that a cure will ultimately be found is made. Attention is called to the predilection of cancer for the left side of the colon and the greater tendency to metastasis in this area. Of the 257 cases of cancer of the right segment of the colon operated on from 1915 to 1925, eighty-nine lived from six months to two years; fifty-five lived from one to four or more years; twenty-five lived six to eight years and twelve are alive eight to nine years after operation.

S. C. Barrow, M.D.

Carcinoma of the Right Segment of the Colon. Charles H. Mayo and William A. Hendricks. Annals of Surg., March, 1926, p. 357.

Gastric and duodenal ulcers.—The author calls attention to the contradiction of methods and results in different recognized clinics in the treatment of gastro-duodenal ulcers. Gastro-enterostomy, he believes, derives its popularity from the ease with which the operation is performed, rather than from the final results. He favors resection rather than gastro-enterostomy, the latter being, in his opinion, simply a drainage process; he classes it as "an operation of despair." He argues that hyperacidity is the cause of ulcer and is responsible for its continuance and that by resecting a portion of the pyloric end of the stomach so much hormone to the acid cells in the cardiac end is removed that the acidity is permanently reduced. The mortality, in the hands of capable surgeons, should be no higher than in gastro-enterostomies: there are no sequelæ such as gastro-jejunal ulcers or late carcinoma, and the percentage of cures is larger.

S. C. Barrow, M.D.

Questions Involved in Operative Procedures in Cases of Gastric and Duodenal Ulcers. August Schachner. Annals of Surg., March, 1926, p. 345.

LYMPHOBLASTOMA [1]

By GEORGE R. MINOT, M.D.,

Boston, Massachusetts

FOUR hundred and seventy-seven cases of all types of lymphoblastoma, excluding lymphatic leukemia, have been studied.[2] Four hundred and one of the patients are dead; 238 were treated by roentgen-ray or radium irradiations, and 163 were not. Sixty-eight per cent of all were males.

The ages at which lymphoblastoma most frequently began were from 20–24, when most of the cases were of the Hodgkin's type. The next ages when individuals were most susceptible were from 35–39. At this time in life other forms of lymphoblastoma than Hodgkin's disease composed the majority of cases. Females tended to have the different forms later in life than males.

At all ages except at the age of puberty the number of males exceeded the females, and a relatively large percentage of women had the condition at or near the time of the menopause.

The duration of lymphoblastoma in the females was apt to be longer than in the males. It tended to be longer in men over 35 years old and in women under 25, than in younger males and older females, except when the latter were from 33–44 years of age.

Comparisons between the lengths of the course of disease in irradiated and non-irradiated patients do not indicate that such treatment significantly affects the duration of lymphoblastoma. It may do so in selected cases and yet be blamed for the greater incidence of irradiated over non-irradiated cases of short duration in patients below the age of 24.

The chances of lymphoblastoma lasting long were relatively great for those first irradiated when their disease was in an early stage. However, the duration of any such case can be paralleled by one given no special form of therapy.

Surgery probably can influence beneficially the duration of some cases of lymphoblastoma, particularly if it is employed early and thoroughly and is followed by irradiation.

The type of case usually treated early by surgery or by irradiation is apt to be the same as that destined by nature to last a long time.

The average duration of lymphoblastoma in the 401 deceased patients was 2.76 years, yet about 10 per cent of both the irradiated and non-irradiated had the disease for six or more years. A greater percentage of the 76 living patients have had lymphoblastoma this long period of time. Although among them the frequency of surgical and early irradiation treatment is greater than for the deceased group, the treatment by modern methods will explain at the best but partially the increased percentage of cases of long duration.

Irradiation is undoubtedly of great value to patients with lymphoblastoma; it alleviates symptoms, decreases the size of lesions, and improves the patients' efficiency, in spite of the fact that it does not appear to influence importantly the duration of the disease.

Twenty-five per cent of 477 patients (401 dead, 76 living) with lymphoblastoma, exclusive of lymphatic leukemia, had as their initial symptom one referable to an abdominal lesion.[3] Twenty per cent of the deceased without such initial symptoms had symptoms referable to abdominal disease early in the course of their illness.

[1] From the Medical Service of the Collis P. Huntington Memorial Hospital of Harvard University. A summary of information presented at the meeting of the Radiological Society of North America, held at Cleveland, December, 1925. The complete data appear in two papers by George R. Minot and Raphael Isaacs, the summaries of which are here presented.

[2] I. Age and Sex Incidence, Duration of Disease, and the Effect of Roentgen-ray and Radium Irradiation and Surgery. Jour. Am. Med. Assoc., April 17 and 24, 1926.

[3] II. Aspects Concerning Abdominal Lesions, Especially Their Production of Early Symptoms. Am. Jour. Med. Sci. (in press).

Late in the disease such symptoms occurred with very great frequency.

Symptoms due to lymphoblastoma within the abdomen are protean and may simulate many kinds of disorders. They often lead to an incorrect diagnosis, but need not necessarily do so if the condition be recalled and all facts evaluated properly.

Abdominal and back pain, often intense, pains in the legs, and various gastro-intestinal symptoms may be prominent early ones. Genito-urinary symptoms, jaundice, signs of invasion of the pancreas, adrenals, and spinal cord are apt to appear late. Fever and skin manifestations may occur early and even be initial when the chief lesion is in the abdomen. Pregnancy may run its normal course in patients with lymphoblastoma and is not unusual.

In 27 per cent of the 119 cases with initial symptoms referable to abdominal lesions there was enlargement of the lymph nodes in the groins early, and at this time only 23 per cent had enlargement of other external nodes.

Cases of this sort occur more often in the later than in the earlier years of life; even so, cases with early, but not initial, symptoms referable to abdominal lymphoblastoma occur particularly in the third decade of life.

After the appearance of symptoms referable to an abdominal lesion, the prognosis for a long duration of life is worse than when such manifestations are absent.

Irradiation of abdominal lesions can alleviate markedly these patients' symptoms. It has not prolonged definitely, on the average, the duration of the disease, but probably occasionally can do so. Likewise, rarely the duration of a case may be extended by a radical surgical operation.

RADIOTHERAPY FOR LYMPHOBLASTOMA [1]

By ARTHUR U. DESJARDINS, M.D., Section on Radium and Roentgen-ray Therapy,
ROCHESTER, MINNESOTA

IN 1923[2] a study was made of seventy-three cases of Hodgkin's disease and fifty-five cases of lymphosarcoma in order to ascertain the average duration of these diseases from the onset of symptoms to death, when no systematic treatment was given. In all cases the diagnosis was based on microscopic findings. The average duration of Hodgkin's disease was two years and seven months, and of lymphosarcoma, two years and five and one-half months. Granting that at best such a determination can be only approximate, it is nevertheless suggestive of a close relationship between these two diseases, or, according to an increasing number of pathologists, between these two phases of one and the same disease. The purpose of this study was to obtain a rough basis of comparison by which to measure any prolongation of life that might be produced by radiotherapy. The more or less marked improvement in the physical condition of patients suffering from lymphoblastoma following the correct application of radiotherapy is well known. However, what effect, if any, such treatment might have on the average duration of the disease has apparently never been determined.

My object in this paper is to review a second series of cases of lymphoblastoma in which more or less systematic treatment with radium or roentgen rays, or with both agents combined, was given. In analyzing this second series I have also sought to derive as much clinical information as possible by classifying and tabulating the various manifestations of the disease (symptoms, physical findings, incidence, and so forth), as in the previous study.

The reservations made in connection with the series reviewed in 1923 apply to the present series. In many of the histories points of importance for such a study are either not mentioned or are stated ambiguously. Of course, this is sometimes due to the faulty memory of patients. The painless insidiousness of the disease makes it impossible for many patients to remember when they first became aware of illness. For many persons pain is the one criterion of illness. Health may go and tumors may grow unnoted or unheeded so long as pain is absent. Some patients do not seek relief until symptoms threatening their very existence force themselves on their attention.

In the cases in this series all the patients registered at the Mayo Clinic during the four-year period from 1920 to 1923, inclusive. Biopsy had established the diagnosis definitely (Table I).

There were 57 cases of Hodgkin's disease and 126 cases of lymphosarcoma. These figures are interesting when compared with those of the series of cases for the five-year period reported in 1923, in which there were 135 of Hodgkin's disease and 102 of lymphosarcoma. The natural question is: Why should the later series contain such a preponderance of cases of lymphosarcoma over Hodgkin's disease? The difference is a good index of the change which is taking place in the views of many pathologists, who, in recent years, have shown a tendency to label some cases frankly "Hodgkin's disease" or "lymphosarcoma" and others "lymphosarcoma (Hodgkin's type)," whereas perhaps all of these might just as well have been classified as cases of "Hodgkin's disease (lymphosarcoma type)." This classification is based wholly on whether the cellular features of Hodgkin's disease or the fibrous connective tissue characteristic of lymphosarcoma predominated. Between these two extremes fall many cases in which the microscopic

[1] Read before the Radiological Society of North America, Cleveland, December 7-11, 1925.

[2] Desjardins, A. U., and Ford, Frances A.: Hodgkin's disease and lymphosarcoma, a clinical and statistical study. Jour. Am. Med. Assn., Sept. 15, 1923, LXXXI, 925-927.

TABLE I

PATIENTS LIVING AND DEAD, JANUARY 1, 1924

Year	Hodgkin's Disease				Lymphosarcoma			
	Patients	Heard from	Living	Dead	Patients	Heard from	Living	Dead
1920	15	12	2	10	27	20	6	14
1921	16	14	4	10	30	22	5	17
1922	18	16	5	11	26	20	5	15
1923	8	5		5	43	32	9	23
Total	57	47	11	36	126	94	25	69

appearance represents a mixture, the interpretation of which depends on the view of the individual pathologist.

Table I shows that, of the 47 patients with Hodgkin's disease concerning whom data could be obtained, 11 (23 per cent) were living January 1, 1925; of the 94 patients with lymphosarcoma, 25 (27 per cent) were living January 1, 1925, as compared with only 11 per cent for each group of the earlier series. At first sight one might be tempted to ascribe this difference to the treatment, but in the former series three years had elapsed whereas in the latter series only one year had intervened between the inquiry and the end of the period covered by it.

One patient with Hodgkin's disease, who became ill at the age of twenty-four, has been able to accommodate himself to it for fifteen years and is still in fairly good health. Another patient is known to have had the disease nine and one-half years and is still active. A third patient is living after suffering from Hodgkin's disease for six years, and five other patients have resisted it for five years (Table II).

In the lymphosarcoma group, one patient had survived twenty-five years, one eight years, one seven years, three six years, and two five years. When this table is compared with a corresponding one for the series of 1915 to 1920, it seems obvious that the ability of a patient to survive in spite of the disease depends, not on treatment, but on factors within himself.

The male appears to be two and one-tenth times more vulnerable to Hodgkin's disease and four and a half times more susceptible to lymphosarcoma than the female (Table III). This is in close accord with the data of the earlier series, in which the male was shown to be two and three-tenths times more vulnerable to Hodgkin's disease and four and four-tenths times more susceptible to lymphosarcoma than the female.

The rate of incidence by decades, given in Table III, is more graphically represented by Figure 1. Here, again, is evidence of the changing attitude of pathologists. The chart illustrating the cases of Hodgkin's disease in this series is almost a duplicate of that for the cases in the series of 1915 to 1920 and again shows the maximal incidence during the third and fourth decades. The chart illustrating lymphosarcoma in the series of 1920 to 1923 differs from that for the series of 1915 to 1920 in one particular: it shows during the second and third decades an initial rise in incidence. This difference can be explained only by the difference of opinion with regard to pathology. In every other respect the later chart follows closely

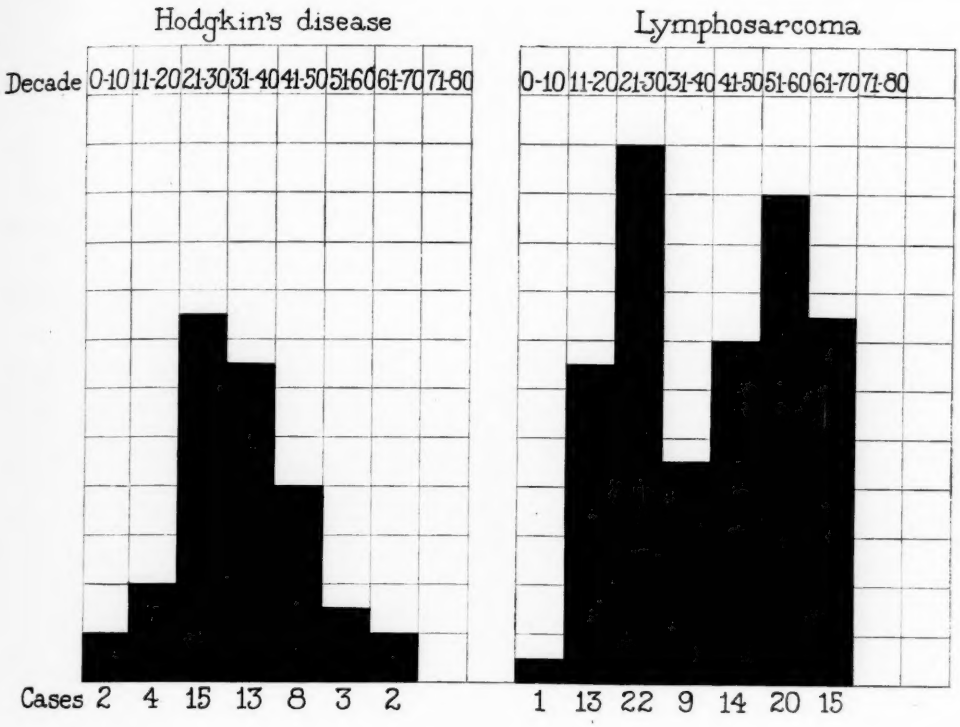

Fig. 1. Incidence of Hodgkin's disease and of lymphosarcoma.

the earlier one, and shows the same maximal incidence during the fifth, sixth and seventh decades.

The percentage occurrence of almost every symptom, except adenopathy, is found appreciably increased in the series of 1920 to 1923 over that in the series of 1915 to 1920 (Table IV). As the relative percentages for the different symptoms remain approximately the same, the general increase is probably due to greater care in taking the histories.

A general parallelism is apparent in the symptoms manifested by these two varieties of disease. Such discrepancies as are seen in Table IV are bound to occur between any dual group of cases. For instance, in this series cough was more than twice as prevalent in the cases of Hodgkin's disease as in those of lymphosarcoma, the percentage of occurrence being 50 and 21, respectively.

On reviewing the histories I was again impressed by the frequency with which the adenopathy seemed to be related to common disturbances around the mouth and nasopharynx, particularly in the cases of Hodgkin's disease. In several cases persistent adenopathy appeared after pulmonary infection, the patients stating that they had been quite well until they developed influenza.

The distribution of adenopathy given in Table V is of relative value only, because the degree and extent of enlargement of the lymph nodes depends on the stage of the disease at the time the patients were examined.

Ever since I became interested in lymphoblastoma I have had the impression that

TABLE II

LENGTH OF SURVIVAL OF PATIENTS LIVING JANUARY 1, 1925, GROUPED ACCORDING TO DECADE IN WHICH SYMPTOMS BEGAN

Decade	Hodgkin's disease				Lymphosarcoma			
	Sex	Age at onset	Duration		Sex	Age at onset	Duration	
			Years	Months			Years	Months
11 to 20.....	M	16	5	6	M	19	8	
					M	19	25	
					M	19	6	6
21 to 30.....	F	24	5	6	M	21	2	4
	F	25	5		M	21	2	6
	M	24	15		M	24	8	
	M	23	9	6	M	25	6	3
	F	26	5		M	28	5	8
					F	26	5	
					M	27	4	6
					M	25	7	
					F	24	3	7
					M	25	2	
31 to 40.....	M	40	3	6	M	32	4	2
	M	31	6		M	40	3	5
41 to 50.....	M	43	4	4	F	47	2	1
	M	43	3	7				
51 to 60.....					M	52	2	8
					F	51	2	4
					M	55	5	
					M	53	4	6
					F	60	4	9
					M	59	4	3
					M	51	1	7
61 to 70.....	F	67	5	2	M	68	3	3
					M	66	1	8
Total	M. 7 F. 4				M. 20 F. 5			
	Average age at onset M. 31 yrs., 6 mo. F. 35 yrs., 6 mo. Average duration M. 6 yrs., 9 mo. F. 5 yrs., 2 mo.				Average age at onset M. 36 yrs. F. 41 yrs., 6 mo. Average duration M. 5 yrs., 5 mo. F. 3 yrs., 7 mo.			

TABLE III

SEX INCIDENCE OF HODGKIN'S DISEASE AND OF LYMPHOSARCOMA BY DECADES[3]

Decade	Hodgkin's disease			Lymphosarcoma		
	Male	Female	Total	Male	Female	Total
1 to 10	2		2	1		1
11 to 20	2	2	4	13		13
21 to 30	7	8	15	17	5	22
31 to 40	10	3	13	9		9
41 to 50	7	1	8	10	4	14
51 to 60	3		3	15	5	20
61 to 70	1	1	2	12	3	15
Total	32	15	47	77	17	94

[3] Incidence based on the age at onset of symptoms.

TABLE IV

CHIEF SYMPTOMS IN 57 CASES OF HODGKIN'S DISEASE AND 126 CASES OF LYMPHOSARCOMA

Symptoms	Hodgkin's disease		Lymphosarcoma	
	Cases	Per cent	Cases	Per cent
Enlargement of lymph nodes	57	100	118	94
Loss of weight	35	61	84	67
Loss of strength	41	72	90	71
Fever	22	39	32	25
Pallor	34	60	54	43
Dyspnea or shortness of breath	22	39	34	27
Cough	28	50	27	21
Venous engorgement or edema	11	21	25	20
Pruritus (general or local)	25	44	22	17
Pain	20	35	59	47

in Hodgkin's disease adenopathy appears first in the cervical nodes and gradually extends downward, involving progressively the axillary, the mediastinal, and later the abdominal and inguinal nodes, whereas in lymphosarcoma the adenopathy tends to spread in the opposite order, the abdominal and inguinal nodes being attacked first. If such a difference could be established it would tend to support the belief that in lymphosarcoma the source of infection—or whatever gives rise to the disease—is to be sought in the gastro-intestinal tract or in the pelvic organs.

Most of the cases of lymphosarcoma listed under lesions of stomach and intestines

TABLE V

PHYSICAL FINDINGS IN 57 CASES OF HODGKIN'S DISEASE AND 126 CASES OF LYMPHOSARCOMA

Distribution of Adenopathy and Other Lesions	Hodgkin's disease		Lymphosarcoma	
	Cases	Per cent	Cases	Per cent
Adenopathy				
Cervical	57	100	99	78
Axillary	37	65	70	55
Inguinal	32	56	68	54
Mediastinal	31	55	33	26
Abdominal	15	26	49	31
Nasopharynx including tonsils			3	2
Splenic enlargement	4	7	13	10
Lesions of stomach and intestines			13	10
Hydrothorax	5	8	15	12
Ascites	1	2	9	7
Leukocytosis (11,000)	16	28	30	24

were, so to speak, accidental discoveries made in the course of operations generally undertaken to determine the cause of a patient's symptoms. In five cases a lesion of the stomach, alone or associated with tributary adenopathy, was found. In one case the gall bladder and liver were invaded. In one case there was a retroperitoneal tumor extending to the right kidney, with regional adenopathy and evidence of erosive action on the spine. The mesenteric nodes alone were involved in one case. In none of these cases was there any evidence of disease in the superficial lymphatic groups.

Three other cases of lymphosarcoma discovered on microscopic examination of tissues surgically excised could not be listed in Table V. In one, the thyroid gland was involved; in another, the orbit (metastatic from the left cervical nodes), and in the third case the disease had taken the form of an extradural tumor of the spinal cord, without other gross manifestations. An unusual distribution of metastatic foci had occurred in several cases of lymphosarcoma. There were foci in the sternum; in the skin over the scapula; in the breast; in the forearm; in the back, and in the lungs, in one case each. Why such metastatic vagaries should be so much less common in Hodgkin's disease is not clear.

In the cases of Hodgkin's disease the highest degree of leukocytosis was represented by a leukocyte count of 41,200; in those of lymphosarcoma by a count of 39,100. However, in one case of lymphosarcoma the leukocytes numbered only 2,000, and less pronounced leukopenia was present in three other cases.

The one outstanding item of information to be derived from this inquiry is shown in Table VI. The average duration of disease in this series was three years and two months for the cases of Hodgkin's disease, and two years and four months for those of lymphosarcoma. As most of the cases had been treated more or less systematically by radiotherapy, and as the average duration of the disease in the cases included in the series of 1915 to 1920 (without systematic treatment) was approximately two years and six months, it does not appear that radium and roentgen-ray treatment prolongs life to a notable

TABLE VI

AVERAGE DURATION OF DISEASE FROM THE ONSET OF SYMPTOMS UNTIL DEATH IN 49 CASES OF HODGKIN'S DISEASE AND 97 CASES OF LYMPHOSARCOMA

Decade of incidence	Hodgkin's disease			Lymphosarcoma		
	Cases	Average duration of disease		Cases	Average duration of disease	
		Years	Months		Years	Months
1 to 10	2	1	1	1	1	6
11 to 20	4	6	2	16	3	6
21 to 30	17	4	3	21	3	6
31 to 40	12	2	8	10	3	7
41 to 50	10	3	6	13	2	11
51 to 60	2	1	6	20	2	9
61 to 70	2	2	11	15	1	2
71 to 80				1		3
Average for series		3	2		2	4

TABLE VII

LENGTH OF SURVIVAL OF PATIENTS STILL LIVING

Time	Hodgkin's disease		Lymphosarcoma	
	Patients	Per cent	Patients	Per cent
Two years or less			3	12
Three years or less			4	15
Four years or less	2	17	4	15
Five years or less	4	33	8	31
More than five years	6	50	7	27
Total	12	100	26	100

degree. The prolongation of life to three years and two months in the group with Hodgkin's disease is probably more apparent than real, especially if the difference in lapse of time is considered. If this study had been made one year later it is likely that the average duration of the disease would have been approximately the same.

Another factor should perhaps enter into the equation, the amount of treatment each patient received. For various reasons some patients were not treated as frequently or as regularly as others, and the result of this investigation might have been altered materially if the cases had been classified also according to the treatment received. I shall review this series of cases at a later date, when this factor will be considered.

As a result of this study one may assume that radiotherapy does not prolong the life of patients suffering from lymphoblastoma. However, this does not mean that radiotherapy does not exert any influence on the disease. On the contrary, it is well known that its clinical manifestations can generally be controlled, and that many patients can be restored to a relatively normal state of health for long periods. Massive enlargement of the cervical, axillary and inguinal glands, and voluminous mediastinal and retroperitoneal adenopathy can be obliterated. Distressing secondary phenomena, such as dyspnea, venous engorgement, toxic pruritus and pleural effusion, can often be relieved. Moreover, the reaction of lymphoblastomatous deposits to irradiation is so characteristic as to constitute a valuable therapeutic test when biopsy is not possible.

DISCUSSION

DR. R. H. STEVENS (Detroit): There has been so much material presented here to-day that I hesitate to add something different which may confuse the issue. During the past year and a half we have been following out a little different plan of radiation, which so far seems to offer some hope of improvement over the general method of radiation by radium and X-ray, but concerning which, in view of the statistics that have been presented, we feel we ought not to say very much. It is preliminary work. We have been injecting a number of cases with chloride of radium either before or after X-radiation. We have had two cases of myelogenous leukemia, treated with X-radiation. One of them, a white woman aged 40, had arrived at a point where she did not respond any more—she had become resistant. She received three injections of 200 micrograms of radium about six weeks apart, and her blood picture changed very soon after. She has had no radiation since October, 1924, and no injections of radium since February, 1925, and the blood picture at the present time is perfectly normal and the patient is clinically well—we see no evidence whatever of the disease. Of course, we understand that some of these cases may go on for as long a period as that without any treatment at all.

Another case of myelogenous leukemia, a colored woman about 30 years of age, has had very little X-radiation and two injections—I think—and her blood picture has been normal for about a year. We injected another case, a colored man with myelogenous leukemia of a rather acute type, over a year ago. His blood picture changed to a very great improvement after the injection, but he died soon—within two months, I think—after the last injection. He had had a good deal of X-radiation.

We have had two cases of Hodgkin's disease which we have been treating, one for over a year. This man had some X-radiation, to begin with, over a year ago, but during the past year he has had no radiation whatever except two or three injections of radium—about one or two hundred micrograms. He has had no injections for eight or ten months, and has kept in very good condition. There are still one or two small nodes down opposite the clavicle which have not increased in size in about a year. He had some small nodes along the bronchial tree in the lungs, and they have disappeared.

There is another case we have not treated so long, to which we gave some X-radiation. He did not improve much and we gave him an injection of 100 micrograms of radium. Almost immediately there was a severe reaction, with marked increase of nodes over the body generally. The man became very sick and we let him go for about two or three weeks and then gave him small doses of X-ray; with that, the nodes very promptly disappeared and he improved materially. We then allowed him to go about six weeks before we gave him another injection. That was about three weeks ago. Five or six days later nodes the size of a cherry broke out subcutaneously all over his abdomen and chest. The man became anemic, weakened, and we were almost afraid he was

going to die: the reaction was most severe. We have given him a little deep X-ray therapy, and this past week his condition has practically cleared up again, showing, I think, that there is a sensitization in some way produced by this injection of radium.[1]

I wonder if any one else has had experience along this line, and, if so, I shall be glad to hear from him.

DR. SHERWOOD MOORE (St. Louis): I wish to express my great appreciation of the instructive papers we have listened to, and I would like to ask a question. The Doctor has just asked about certain of these cases taking on a leukemic blood picture after radiation. I recall a case of polycythemia, on which I had some work in conjunction with Dr. Minot, and though I did not see this patient at the time of exitus, I was given to understand that she died a leukemic death. The last case was that of a child with Hodgkin's disease that took on a picture of myelogenous leukemia. I should like to inquire what the experience of others has been, and also whether any one has any theory as to the mechanism at work which produces this condition.

DR. HULST (Grand Rapids, Mich.): While there can be no doubt that the general conclusions arrived at are correct, I think some here may be interested to have me tell something about a case which it was my privilege to demonstrate in the first meeting of the Radiological Society at Niagara Falls, and later in Chicago. This was a case of Hodgkin's disease, diagnosed, not by one man, but by several clinicians in the United States, carefully studied at one of our universities, more or less carefully examined by perhaps five or six hundred men of our specialty, and therefore of noteworthy interest. When the case was demonstrated at these various meetings, we were told, of course, that he would perhaps for a time improve, but that eventually he would pass the same road that all others passed. This case, however, seemed to be an exception. It is probably about twelve years (I have not the figures), during which time he has received no treatment, and he seems to be perfectly well. Of course, it might be said that this was a a case of lymphosarcoma, but on account of the diagnoses made at various places by such competent men, it is hardly probable that that was the case. There is one thing in connection with this that I would like to emphasize, and that is that the disease began in the neck and extended downward, as it usually does. The case was chronic and did not respond very well. We took every precaution with all the foci, to eradicate them so far as we could find them. One other interesting point about this case was a mass of glands in the armpit, which had been rayed, and which we stopped raying for about six months. All of a sudden the skin over this area became red; evidently pus was present. I opened it, and the whole area seemed yellow. I commenced to express the contents and got a handful of dead glands out of this area. The wound, after that, in due time closed and later there were no further developments from it. The same thing happened upon a second occasion about six months after, in the neck; similarly a bunch of glands came out. Gradually the patient improved and grew so well that there was no further reason for raying. He went to a neighboring city and is living there now, doing his usual work, there being no indication of further trouble. I mention this not because I think that it was necessarily the X-ray that cured him. This is the only case of this kind in my possession; it was never reported but I mention it in order to emphasize the fact that we must not be too sure of the incurability of Hodgkin's disease. This man was an insurance agent. When I first told him it was Hodgkin's disease, he said, "Then, Doctor, I have got to die." I said, "Yes, we all have to die, but we don't know how

[1] Two months following this report, this patient died in a similar reaction. Diagnosis at time of death was sarcoma: no autopsy.

soon, and possibly you may not die from this; you may be an exception." It proved that he *was* an exception.

DR. MINOT (closing): I agree with what Dr. Stone[2] has said concerning tuberculosis. Tuberculosis may be, also, the immediate cause of death in a patient with Hodgkin's disease. With regard to the question of one form of lymphoblastoma passing into another: I agree with what Dr. Stone said, that a blood picture resembling that of lymphatic leukemia may develop in a case previously diagnosed as Hodgkin's disease. There is some question, however, whether or not it is correct to say that such a case has become one of lymphatic leukemia, simply because there is a blood picture suggesting this condition. When a patient with pernicious anemia shows signs of so-called bone marrow dissolution, so that there appear in the blood many forms of immature nucleated marrow cells, one does not consider that myelogenous leukemia has developed. There is no doubt that the type of lymphoblastoma called "pseudo-leukemia" has exactly the same pathologic histology as that form known as "lymphatic leukemia." The distinction of these two types depends only on what elements appear in the blood stream, and a given case may at one time have a leukemic blood picture and at another time an aleukemic one, and thus be given different names at various times. It remains a problam as to just why some cases have many lymphocytes in their blood and others do not.

I was pleased to hear bone lesions mentioned. Sir William Osler referred to cases of multiple bone lesions associated with fundamental disease of the lymphoid tissue throughout the body. They are very rare. We have seen not infrequently bone lesions in small numbers in cases of lymphoblastoma.

It is problematical as to how long a patient with chronic myelogenous leukemia may have a blood picture that approximates normal. I do know that cases both treated and untreated may have no very striking deviation from normal in the formed elements of their blood for three to four years and that this disease may last for even more than ten years. I have not seen cases of Hodgkin's disease develop a blood picture like that of myelogenous leukemia, but Symmers has pointed out certain similarities between these two conditions that are worthy of attention.

DR. A. U. DESJARDINS (closing): In the series of such cases that I reported in 1923, which represented patients coming to the Mayo Clinic between 1915 and 1920, there were two with ulceration of the sternum. In both of these I felt that the ulceration was due to erosive pressure from lymphomatous masses within the thorax. However, it was impossible to determine this definitely; the erosion may have been the result of direct involvement of the bone. In connection with Dr. Johnston's question concerning lymphosarcoma becoming transformed into leukemia, I have seen only one case in which such a possibility could be even entertained. The patient in question had lymphosarcoma and also a marked leukocytosis, but whether the leukocytosis was leukemic, whether it was due to the disease having reached a very advanced stage, or whether it may have been the variety of disease to which Sternberg attached the name of leukosarcoma, I do not know.

[2] No paper has been received from Dr. W. S. Stone for publication.—EDITOR.

RADIO-ACTIVE SUBSTANCES: THEIR THERAPEUTIC USES AND APPLICATIONS

RADIATION OF CANCER OF THE CHEEK

By JOSEPH MUIR, M.D., New York City

INASMUCH as cancer of the cheek is a relatively uncommon malignant lesion, it would seem to be of less clinical importance than similar growths elsewhere located. Owing, however, to its close relation to other oral neoplasms, and to its extreme malignancy when present, it is actually a subject of the most active clinical interest, so that I feel it should have consideration apart from other oral malignancies, such as those of the lip, tongue or pharynx. I fully agree, however, with Simmons, of Boston, who has lately given us much valuable material in relation to this class of malignancies, when he discards the expression "cancer of the cheek, tongue and jaw" in favor of "cancer of the buccal mucous membrane," for the reason that all such growths arise from the mucous membrane and "the problem of treatment is essentially the same wherever situated." Before taking up this problem of treatment, however, it seems advisable to discuss the etiologic factors which apparently determine the location of the neoplasm upon the cheek rather than in other parts of the mouth, and the peculiar mechanical difficulties which a growth so located presents to the therapist, no matter what means of treatment he intends to apply.

Much of the literature relating directly to cancer of the cheek comes to us from those regions where the inhabitants are addicted to betel-nut chewing or the still more deleterious practice of buyo chewing, "buyo" being a combination of buyo leaves, betel-nut, slaked lime and tobacco. We are indebted to Aller G. Ellis of Bankok, Siam, and George G. Davis, formerly a professor at the University of the Philippines, for careful recent studies upon cancer of the cheek as seen in practice in tropical countries, which throw much light upon the importance of irritation in all types of oral malignancies.

The constantly strengthening conviction that chronic irritation is a most important factor in promoting the growth of any neoplasm, nowhere receives more confirmative evidence than in mouth lesions, and for many years betel-nut chewing has been regarded—especially by physicians native to temperate climates practising in the tropics—as a certain cause of oral cancer. Some doubt has been thrown upon this view by the investigations of Ellis among the Siamese, but though he regards the charge as not proven, and based, as yet, upon insufficient evidence, the general conviction that irritation within the mouth is responsible for the malignancies seen there, continues to hold its own. Of Davis's forty-nine cases of cheek cancer, there was a positive history of chewing buyo in forty, or 81 per cent. "In no case is there a history of *not* chewing buyo." Twenty patients were questioned as to where they were accustomed to hold the "chew," and in every individual "the site of the lesion corresponded definitely to the position in which the patient was accustomed to hold the chew. The patients themselves often volunteer the information that the buyo causes the lesion and that that was the side on which the chew was held." Davis believes that the lime—which is added to give a pleasant sweet taste to the betel leaves, which are otherwise very bitter—is the principal irritating cause, though "the chemical properties of the leaves, containing essential oil, and the chemical properties of the nut, containing tannic and gallic acid, may be predisposing factors."

A striking similarity is evident in the history of all these cases of cheek cancer. The patient first notes an involvement of the inner aspect of the cheek, this being at first a small elevated growth in the mucosa. Ulceration rapidly follows; indeed, many patients state that the growth began as an

ulcer. Slight pain is usually felt very early, confined at first to the lesion itself, but "often accompanied by a severe pain of a referred type, radiating to the angle of the jaw or parotid and submaxillary re-

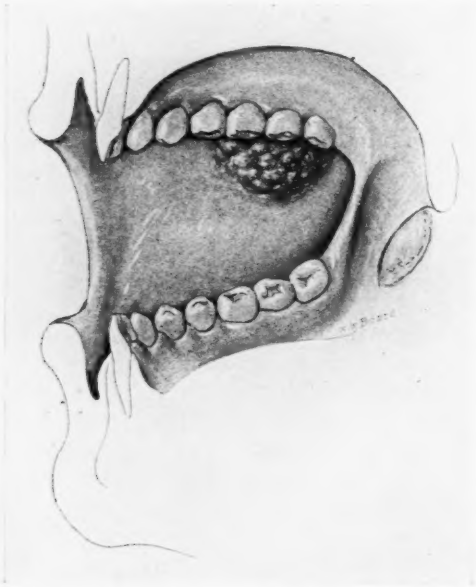

Fig. 1. Cancer of the cheek. Only the lower half of the lesion is visible; the upper part extends into the buccal fold.

gions." There may also be complaint of a burning sensation. The lesion slowly but steadily progresses into a cauliflower mass, projecting from the mucosa into the mouth cavity and eventually making mastication difficult, if not altogether impossible. Abscess formation is likely to supervene, and the great liability of any mouth lesion to secondary infection finds no exception in these cases. "The teeth in the region of the growth fall out early, as the extension of the growth from the cheek to the neighboring gums proceeds." Extension may take any direction, and often appears on the outside of the cheek either by way of the angle of the mouth or by perforation at the original site of ulceration.

Histological examination of excised tissue shows "a marked down-growth of the epithelium below its normal limiting basement membrane in the form of dense strands, with a very marked tendency to the formation of epithelial pearls, and apparent separation of masses of epithelium from direct continuity with that on the surface. The pearls which form so large a part of the structure and have been seen down in the muscle tissue, are frequently almost homogeneous in appearance, having undergone hyaline degeneration or extensive keratinization. The intervening stroma occupies a relatively insignificant part, but in all cases has shown extensive round-cell infiltration. Practically all of the cases have shown a greater or less grade of ulceration, but in none of the cases examined has there been any conclusive evidence that the tumor originated on the basis of a pre-existing ulcer."

The comparison of this description with that of cheek cancers occurring in individuals who have never come in contact with betel "chews" is of decided interest. Blair states that of tumors which arise within the mouth, most of them seem to be in connection with dental or mechanical irritations. Leukoplakia is cited as a cause of some, "and in this connection smoking must be regarded as a factor." When seen upon the oral surface the carcinoma will be of the soft medullary type, first noticed as a small papule which bleeds very easily. This author regards cancer of the cheek as likely to remain localized longer than cancer of the tongue or floor of the mouth, though it is prone to involve the intermaxillary fold. Many years ago, Morestin, a French surgeon who gave especial attention to cancer of the cheek, observed that while the tumor might arise at the corners of the mouth, at the center of the cheek, or at the level of the interdental line, by far the most common location was in the region of the "gingivo-genian cul-de-sac," that is, the angle formed by jaw and chin. But no matter where the lesion arose, it tended to propagate rapidly from above downward, more slowly from below upward, in either event soon involving the lower jaw, and

producing metastasis to the glands in the neck draining these areas. The upper part of the buccal mucosa, on the other hand, long remains immune—"pliable, healthy and elastic"—permitting free movement of the jaws for mastication and other functions. The floor of the mouth was never invaded. Morestin also noted the great rarity of buccal cancers among women, and thought that the progress of these lesions in the female sex had special characteristics which were peculiar to them, and were never observed in men. At the time Morestin wrote the use of tobacco was uncommon among French women, but very common among men. Betel-nut chewing is even more prevalent among women than among men, and the ratio of cheek cancer between betel-nut chewers of either sex is practically identical. These facts are significant in regard to irritation as an etiologic factor.

Sex incidence in cancer of the cheek has been touched upon by most of the writers in our own country. Brewer, for example, found that at the Presbyterian, Roosevelt and General Memorial Hospitals in New York City, 71 sufferers from cheek cancer were men and only 11 women. As regards location—in three cases the growth was limited to the region near the angle of the mouth; in eight it involved the alveolar border; in four the middle area of the cheek, and in seven the posterior area; in twelve, the ulcer had penetrated the cheek and appeared upon the exterior surface. These cases collated by Brewer are probably fairly typical of observations made anywhere in regions where betel-chewing is unknown, and it seems to be pretty generally concluded that with us, tobacco, especially tobacco-chewing, is the chief irritative factor, with dental defects—decayed and broken teeth, badly fitting artificial dentures, and so on—as a close second.

The histology of these growths has been well studied by Means and Forman, of the Ohio State University College of Medicine. As have other investigators, they found the most frequent type of neoplasm in the mouth to be the epidermoid or squamous-cell carcinoma. "The patients bearing this type of tumor give a history of having some form of lesion preceding the development of the cancer. The smoker's burn is one of the frequent initial lesions described by these patients. A small blister occurs which may disappear and re-form again. . . . In order of frequency, the next precancerous lesion occurs as the result of mild traumatism repeated frequently over long periods of time. The irritation of a jagged tooth, or, in many patients, the habit of holding nails, screws, etc., in the mouth, can be discovered in taking the history." Leukoplakia is mentioned as especially noticeable in the history of patients with cancer of the tongue. Other observers have spoken of this as of equal importance in cheek cancer, and the difficulties which arise in patients presenting syphilitic mouth lesions is often noted. In those infected with syphilis, the mouth condition will improve under specific treatment, but actually, though the luetic condition may be benefited, if malignancy is co-existent, as is not infrequently the case, the delay in giving the cancer proper treatment is likely to prove fatal to the patient. Simmons remarks that though he always has a Wassermann test made upon the blood, he disregards a positive report if the mouth lesion is suspicious, and treats it as cancer.

Glandular metastasis seems to be relatively infrequent when the original lesion follows irritation from betel-nut chewing. In the cheek cancers seen here and in Europe, on the other hand, it is frequent—almost universal—and appears very early in the course of the disease. Simmons found multiple lesions very common, in most instances associated with leukoplakia and syphilis. He distinguishes between recurrence after surgical excision and "reoccurrence," by which he means the appearance of a second lesion in another area of the cheek, after the first has been excised, which does not seem to have any direct relation to the first growth, other than that

of having in all probability been provoked by a common cause.

The prognosis in all cases of cancer of the cheek is not to be regarded as cheerful. Under all methods of treatment heretofore employed, the number of cures has been lamentably small, and death from recurrence or malignant metastasis very frequent. Of the fourteen cases which Clark treated by electrothermic methods, six suffered recurrence; seven presented cervical metastases and all of these recurred after treatment. However, eight patients remained well for periods ranging from four years to four months. New, of the Mayo Clinic, reported on twenty-one patients who had no glandular involvement and were treated with cautery and radium; nineteen were men and two women. Fourteen of these patients remained free from local recurrence from six to eighteen months, though in two of these glandular metastasis later necessitated resection. At the time this report was made, more than seven years ago, the employment of radium in addition to the cautery had been but recently instituted at this clinic. Some two years previously, Michaux had published an account of a case treated in Paris by Dominici, which appears to be the first application of radium to a malignant lesion of the cheek in that city. The patient presented three lesions, the original site being in the right cheek, appearing in April, 1915. In September of the same year another nodule was discovered in the left cheek, and coincidently there was metastasis to the left cervical glands. An application of 48 milligrammes of radium sulphate in a silver tube was made for six days, first to the initial lesion and later to the growth upon the left cheek. Both the lesions disappeared and it was planned to make surface applications upon the skin of the neck. The author, however, did not hold out any hope of ultimate recovery to this patient, believing the malignancy too widely disseminated before treatment was instituted, to make complete eradication possible. He regarded the case, however, as indicative of the usefulness of radium in the buccal region, and looked for better results when treatment could be begun earlier.

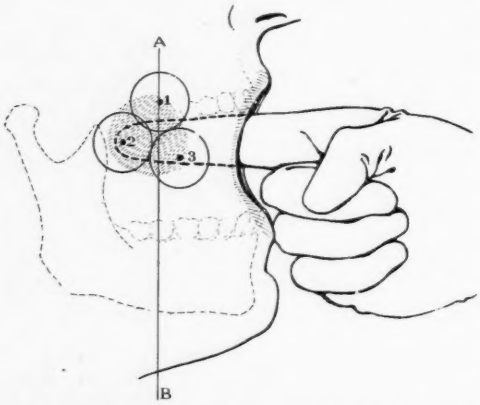

Fig. 2. The lesion is indicated by the shaded area. Numbers 1, 2, and 3 show points of insertion of implanter and position of seeds. The seeds are implanted on external surface of cheek, counter-pressure being exerted by the finger within the buccal cavity. The line of section shown in Figure 3 is represented here by the line *AB*.

The progress made in France in the application of radium therapy to buccal cancer can to some extent be measured by the reports made at the Strasbourg conference of radiotherapists held in 1923. There papers were presented by Régaud, the clinical associate of Madame Curie, and Bayet, of Brussels, which may be considered representative of the work done along these lines in France and Belgium. Bayet stressed particularly the radio-resistance of spino-cellular cancer, the type most often seen in the buccal cavity, and the prime necessity of eliminating glandular metastasis, the neglect of which, he felt, was the cause of most of the failures attributed to radium. The rays should be so applied that not only the original lesion but a wide zone of surrounding tissue will come under their influence. The dose should be large enough to accomplish sterilization of the malignant zone, for too small dosage simply serves to favor recurrence and glandular metastasis. All the glands likely to be involved should be thoroughly irradiated

before treatment is applied to the initial lesion, and he also considered irradiation essential in all cases of surgical removal of this lesion. All interventions upon the buccal cavity should be preceded by most thorough disinfection of the entire field, and removal of all carious teeth. He applied the radium either in needles or in the form of emanation, by implantation of bare tubes. He had formerly used needles on the glandular metastases as well, but had abandoned this method in favor of surface applications of platinum tubes. In the needles, 0.6 mgr. of element was used, screened with 5/10 millimeter thickness of platinum.

Régaud reported on eleven cases of cheek cancer. Ten of these were regarded as inoperable, five of them being recurrences after surgery. Two patients treated by the implantation of bare tubes died within six months without any notable amelioration; one remained well for twenty-two months after treatment. Another patient, treated by intrabuccal application with a mold of dental compound, had remained well for three years. Still another had the cheek opened and two separate radium applications made, the first by holding the radium in a mold, the second by "radiumpuncture." This patient had survived twenty-six months up to the time of the report.

On the entire series, the percentage of cures extending over a year or more was 36.3. Régaud considers the cheek the most favorable location for radium treatment of any mouth lesion. "An epidermoid localized upon the cheek, with or without invasion of the skin, but not involving the jaws in any way, is easily cured by local application — radiumpuncture with ultra-penetrant rays." He does not seem to share the general opinion that cheek lesions are peculiarly obstinate when attacked by radium.

A very different view is that of Albert Soiland, of Los Angeles, who says that cancerous lesions of the inner surface of the cheek deserve especial consideration if only for their rather tardy and unwilling response to radiation. His radium results upon this neoplasm "have not been brilliant." Grier, of Pittsburgh, seems to share his opinion, although he admits that lesions situated entirely within the mouth are too inaccessible to roentgen rays to admit of

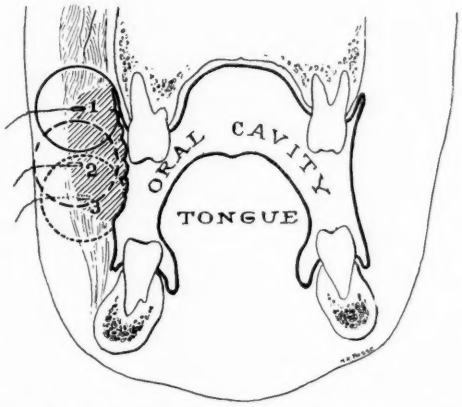

Fig. 3. Sectional view of implanted lesion. Malignant area indicated by shading; circles surrounding Numbers 1, 2 and 3 show zone of radiation about each implanted seed, 2 being posterior, and 3 anterior to 1. The threads by which the seeds are withdrawn when sufficient radiation has been given, are shown issuing from the points of implantation; sufficient length of thread is left upon the surface of the cheek to permit ready seizure with forceps at time of withdrawal.

application of this form of radiation, so that "radium is indispensable in these cases, and, up to a certain stage in the progress of the disease, usually produces satisfactory and sometimes remarkable results." Technic, he feels, plays a more important part in mouth lesions than in any other location. Heavy filtration is necessary, and for this he uses 1 mm. of brass with 2 mm. of rubber for 50 mgr. of radium left in place for 12 to 15 hours. The tube is laid on the surface, held in place by an applicator of sheet lead bandaged to the proper position. He believes the cervical region should be thoroughly radiated before any attempt is made to treat the original site of malignancy, as it has been his observation that the majority of patients with malignant disease of the mouth die of metastases, so "the treatment of these metastases is an

absolutely essential part of any plan of treatment."

I am thoroughly in accord with all that has been cited in regard to the necessity of primary consideration of all areas where metastasis can possibly occur. Deep roentgen therapy apparently gives the best results in controlling malignancy of the cervical glands, and the earlier this is instituted, the better the patient's chances of recovery, or, at least, lengthened life, will be.

The chief difficulty in treating any intrabuccal lesion is the practical certainty of secondary infection, because of the continual presence of pyogenic organisms within even the healthy mouth. This, to my mind, absolutely contra-indicates the employment of implantation methods where the mouth secretions are liable to contaminate the field, a drawback equally applicable to screened needles or bare tubes. To obtain the advantages of even distribution and exact dosage, obtainable only by implantation of the radium, this must be done from the outside, and for such external implantation, the platinum-radon seed offers the best medium. Because of its platinum filtration, there is no danger of this seed's setting up foci of possible infection by inducing sloughing, because of necrosis, such as always follows the use of bare tubes. And as soon as its work is done, the seed can be at once withdrawn—always on the external surface, so that no foreign body remains to cause trouble later on, or even to disturb the mind of the always apprehensive patient.

By this method the precise dose of radium can be accurately estimated, for a cheek lesion is easily palpated, its depth gauged and the seeds deposited accordingly. There is no guess-work, and the radium therapist can be certain that he has applied the gamma rays alone exactly where their effect is desired, leaving the surrounding healthy tissues uninjured.

The method of implantation is so well shown in the accompanying diagrams that description is superfluous. In the case here illustrated, the seeds employed are of 3 millicuries intensity, and are left in place for 10 days, making a total dosage of 333 millicurie hours, each seed producing tissue change of 1 cm. from its point source on all sides.

The very rarity of cheek cancer makes its prompt recognition and treatment of paramount importance. Especially should its early manifestations be understood by dentists and general practitioners, as they are usually the ones who first see these lesions, and it lies in their power to place the patients under proper treatment early enough to make clinical cure possible. It is a matter deserving of more attention than has hitherto been accorded to it.

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THE BIOLOGICAL EFFECT OF RADIUM

By C. F. CHARLTON, M.D., PASADENA, CALIFORNIA

MICROSCOPICAL sections taken at intervals from irradiated growths in process of resolution show a definite sequence of changes for both radium and X-rays (1, 2, 3). These consist of, first, a latent period during which no changes are observed in the tumor cells. At this time, however, an inflammatory reaction is taking place in the stroma. There is hyperemia and exudation of polys and lymphocytes. Following this period alterations appear in the malignant cells: they swell to giant proportions. The third phase is represented by keratinization. This is followed by disintegration and, finally, deposition of fibrous tissue. The lymphocytes, fibroblasts and dilated capillaries dominate in this late picture.

We observe, then, an orderly sequence of changes spread over a considerable length of time but in no way comparable to caustic or thermal effects. In review, we see mesoblastic activity on the scene first and last.

The second phase of the reaction wherein we see the swelling of the malignant cells has given rise to the thought that irradiation generates new electrolytes in the malignant cell, which, in turn, alters osmotic relationships and draws in water (4). It is spoken of as the ultimate effect of irradiation and obviously the nature of the process involved assumes considerable importance.

I have been unable to find any experimental foundation for conclusions in this regard and undertook some with egg white, realizing, of course, that this is not malignant tissue, but since it has a very high swelling rate any deviation consequent to irradiation ought to manifest itself. Using 5 c.c. of egg white I exposed it from 100 to 5,000 milligram-hours. Each specimen was then put in an egg membrane dialyzer, immersed in normal salt and the swelling measured against controls of the same lot of egg white, in the same container, both before and after. The second control, *i.e.*, that one run after the irradiated specimen, usually has a higher rate than the first, because of a certain amount of autolysis taking place in the protein on standing. The results of these experiments reveal a shift in favor of the irradiated specimen only in the extreme high exposures, where molecular disintegration is taking place, as evidenced by the smell of hydrogen sulphid. Under 2,000 milligram-hours there is no shift, and our conclusions are that there is no reason to believe that a change in osmotic properties is accomplished by irradiation applied therapeutically. We join with Ewing (4) when he says, "The ultimate action of rays on cell structure has not been explained by physics or chemistry."

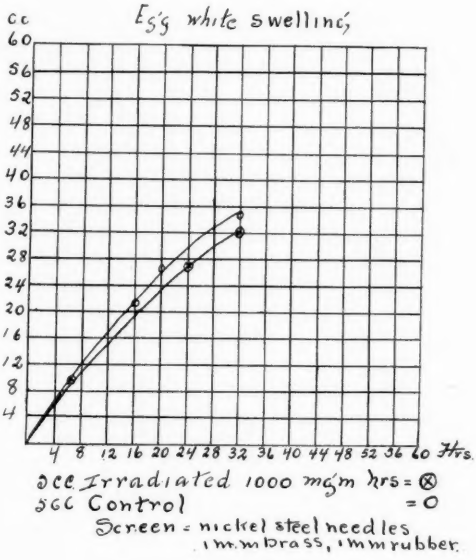

Chart I.

Murphy (5), of the Rockefeller Foundation, experienced negative results when in-

Murphy (5), of the Rockefeller Foundation, experienced negative results when investigating direct effects, and we are facing the fact that a particular susceptibility of tumor cells to direct irradiation has never been established.

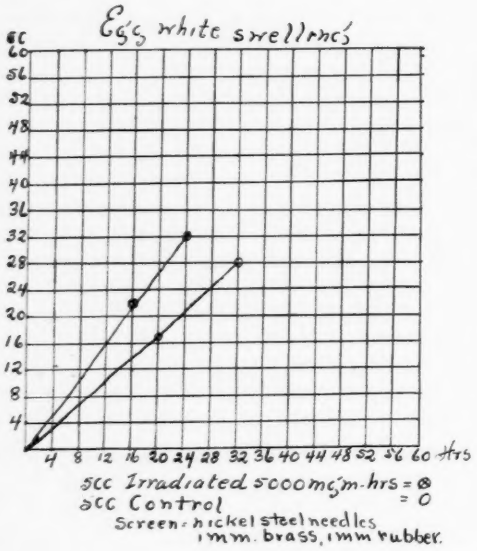

Chart II.

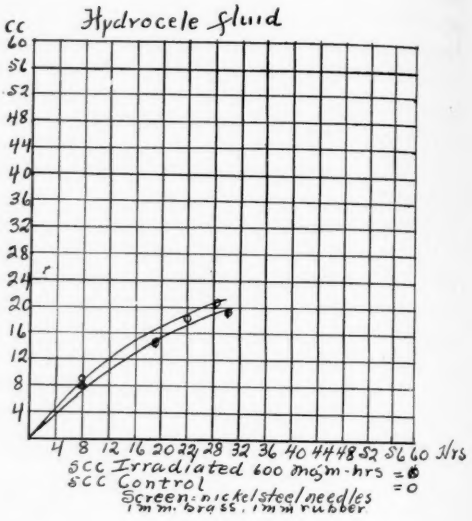

Chart III.

Probably, then, the therapeutic value of row and lymph glands, with excessive irradiation, that one finds in an animal dying of cancer cachexia. This localization of pathology corresponds with the autopsy report from Orange, New Jersey (7).

The explanation of a physiologic response has a much stronger position. Murphy found a drop from 83 to 28 per cent of takes when he previously irradiated the intended site of the graft. And Opitz (6), successor to Kronig, at Freiburg, reports experiments of the same tenor. He observes the same changes in irradiated grafts that one sees in tumors that fail to take, and thus spontaneous regression presents the same picture as that subsequent to irradiation: that irradiation above a certain dosage brings no regression in the tumor but actually hastens its growth: that irradiation of the tumor alone is not as successful as when some of the surrounding tissue is included: that irradiation of the head end of an animal with a graft in its hind leg brought about a regression in the tumor although it was shielded from the rays. He finds the same changes in spleen, bone marrow and lymph glands, with excessive irradiation, that one finds in an animal dying of cancer cachexia. This localization of pathology corresponds with the autopsy report from Orange, New Jersey (7).

these electromagnetic waves lies in the reaction they bring, or, in other words, the mesoblastic response. Metchnikoff (8) developed the phenomenon of phagocytosis from the observation that cell nourishment is a function of the mesodermal germ layer, and when Burrows (9) says cancer may be nothing more than a cellular tissue reaction to a lowered circulation we are gathering observations that make a coherent story of malignancy. Telangiectasis is a form of mesoblastic response and a late manifestation of what Dominici termed an "embryonic regression of vascular supply."

The conception of various susceptibilities for different types of malignant cells becomes transposed to one of mesoblastic vulnerability, for, without the barrier of a basement membrane, the malignant cell is exposed to mesoblastic attack. A closely packed avascular growth, such as the squa-

mous cell type, naturally offers more resistance than the loosely arranged forms.

The findings of Murphy wherein he observed a reduction of over 50 per cent of takes where the intended site of the graft was irradiated, suggest a prophylactic value to irradiation, and, curiously enough, this is supported by an investigation of the experience at such clinics as the Memorial Hospital, New York; that of John G. Clark, Philadelphia; Howard Kelly, Baltimore; Henry Schmitz and Arthur Curtis, Chicago, and Bowing at Rochester. At these clinics, where an aggregate of thousands of cases have been irradiated for benign conditions of the uterus, extending back over a period of fifteen years, not one case of malignancy has been known to develop subsequently.[10]

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DIAGNOSIS AND RESULTS IN THE RADIATION TREATMENT OF SOME MEDULLARY BONE TUMORS [1]

By RALPH E. HERENDEEN, M.D., Memorial Hospital, New York City

THERE probably is no better example of the value of an X-ray examination in diagnosis than in the field of bone tumors.

Here one frequently finds that from the history and clinical examination, the data obtained are insufficient on which to base a working diagnosis. Resort to biopsy appears to be growing less frequent, as the results from this method, the inaccurate or insufficient knowledge derived, the undesirable results that may follow, such as weakening or destruction of the capsule, the opening of blood channels which may permit the dissemination of tumor cells, are more generally or more fully appreciated. Ewing repeatedly stresses the importance or desirability of making a diagnosis without biopsy.

Of course there are numerous instances where the history, clinical findings and other data, when considered along with the radiograph, are necessary factors in arriving at a diagnosis. The roentgenologist who does not avail himself of this help, and who does not see or examine the patient, will find the interpretation of the films more difficult, and his report to the attending physician of less value, perhaps ambiguous and inaccurate. But there are instances when resort to biopsy, all other efforts having failed, is necessary.

In the diagnosis of numerous other diseases, we find the main reliance is not placed upon the radiographic findings but on the results of the examination of secretions, blood, history and clinical findings, bacteriological findings, tissue examination, etc.

In the beginning one finds that if he proceeds in an orderly manner in considering the conditions responsible for the deviation from the normal in size, shape, density, and location of the shadows under examination in the radiograph, a logical conclusion is more easily arrived at. Obviously, the first step is to determine the presence or absence of bone disease. Structural defects and anomalies must be excluded and it may be necessary to roentgenograph the other limb or corresponding part to demonstrate any deviation from the normal.

Having established the presence of disease, one considers infection, changes resulting from chronic constitutional disease, atrophy from disuse or pressure, as possible causes. This consideration brings us, then, to the changes possible from a neoplastic process. Again, one finds it necessary to divide the possibilities of the condition present into two parts, primary and secondary. Here, as in the cases of infection, one must always be sure that the preponderance of the evidence warrants excluding a metastatic process before the diagnosis of a primary bone tumor can be made.

It is not uncommon to exclude all of the above possibilities before a working diagnosis can be reached. After feeling reasonably sure that the process present is a primary bone tumor, the question of degree of malignancy intervenes. At this point, if one can determine whether or not the process is medullary in origin, a long step is taken in determining the degree. It is obvious that the character of the treatment and the prognosis depend upon determining the degree of malignancy.

Although giant-cell tumors may occur in any bone in the body (we have found them in the skull, vertebræ, ribs, pelvis, upper end of the femur and humerus, lower end of the ulna and radius, tibia and fibula), the most common sites are in the ends of the bones at the knee joints, and a tumor in the medullary portion of the distal end of the radius is nine times out of ten a giant-cell tumor.

So we find that the location is one of the

[1] Read before the Radiological Society of North America, at Cleveland, Dec., 1925.

most important points in the diagnosis of giant-cell tumors. Giant-cell tumors may occur in the shaft or at some distance away from the end of the bone, but in these instances the diagnosis is more uncertain and the chances are greater that the tumor is a malignant one, as purely benign processes, other than giant-cell tumors, such as chondromas and cysts in the medulla of bones, are comparatively rare. The typical roentgenographic features of giant-cell tumors are so well known that any description here seems superfluous. It is in the occasional instance where at first glance the appearance simulates a giant-cell tumor, but where on closer inspection something is present or something is lacking in the picture for a typical giant-cell tumor, that further study, obtaining other -- perhaps better — radiographs, films of the chest or films of other bones, consideration of the history, and a complete physical examination, will throw further light on the condition and prevent a serious error in diagnosis and treatment.

The location of the tumor, for example, may be in the medullary portion of the bone or in the end, or in a relatively uncommon location such as the distal end of the tibia, or, in other instances, some distance away from the end of the bone; then, combined perhaps with this unusual location one may find an irregularity in the outline of the tumor, or evidence of active destruction in a certain area. The expansion of the medullary portion of the bone may not be symmetrical, and the evidence of slow growth may be lacking. The white line which limits the border of the tumor may be absent entirely or in places, and the line of demarkation between the tumor and normal bone may be hazy and irregular. Then, again, the process may show a tendency to extend into the medullary portion of the bone; while in other instances, although the process may be symmetrical or circumscribed, it will lack the clean-cut, cyst-like areas and striations which give the trabeculated appearance so common in giant-cell tumors. In these instances, especially if the tumor is at the end of a bone, such as the upper end of the humerus or femur, one should suspect a tumor containing cartilage. Of the conditions least suspected, when the diagnosis of giant-cell tumor is being considered and probably more frequent than any other—or at least second in frequency to giant-cell tumors—are the osteogenic chondrosarcomas.

The next in frequency are the myelomas, and one occasionally finds an early single primary myeloma that has in its early stage some of the features of a giant-cell tumor.

Ewing's tumor, or endothelial myeloma, as he chooses to call it, though medullary in origin, seldom has many of the characteristic features of a giant-cell tumor. Although the process may occupy the end of the shaft of a long bone, it usually extends up or down for a considerable distance, expanding the medullary portion a little but diffusely invading the cortex and seldom ending abruptly as do the giant-cell tumors, and very seldom does one find evidence of limitation of the growth by production of bone; there is an even, diffuse absorption of bone that gives to the X-ray picture a characteristic, striated appearance with loss of normal density such as one could expect in a process of decalcification. The appearance of this tumor in the radiograph is so characteristic and so unlike most other primary bone tumors, that we feel that in many instances the diagnosis of Ewing's tumor can be made from the radiograph. The conditions which simulate it more closely than others are carcinomatous metastases and especially metastases from hypernephroma.

Giant-cell tumors, chondrosarcomas and Ewing's tumor all respond differently and in characteristic ways to radiation therapy. In the case of giant-cell tumors, following a fairly heavy dose of radiation, a reaction is found which reaches its height in from three to six weeks. The reaction is characterized by redness, swelling, tenderness,—sometimes to such a degree that one may be led to suspect that the growth has taken on marked activity; however, as time goes on the reaction subsides, redness, tenderness

and swelling disappear, and the tumor becomes firm to the touch. Radiographs made later often demonstrate definitely that the tumor is becoming well calcified.

In the case of chondrosarcomas this reaction to radiation is uncommon; the tumor responds slowly to radiation, that is, in comparison to other malignant bone tumors. It is sometimes a matter of many weeks before any effect of the treatment is visible, along with the diminution in the size of the tumor. The pain also slowly disappears and at this time a radiograph may demonstrate some attempt at ossification or repair of the bone destroyed by the tumor.

There probably is no bone tumor that shows a more immediate and active response to radiation than endothelial myeloma, or Ewing's tumor, especially when occurring in children or young adults, as most of them do. The knowledge of this prompt reaction sometimes serves as a guide in the diagnosis. We have never been able to demonstrate this response in any of the above-mentioned conditions. Metastases to bones from hypernephroma have usually shown but little response to radiation.

The soft-part tumor in endothelioma of bone is often quite bulky, and frequently, following a light dose of radiation, diminishes rapidly in size; along with this is a prompt regeneration of bone. This response to radiation in many instances is so marked as to be quite startling and may lead one to predict a prognosis more optimistic than observations made later warrant. There can be no doubt as to the great palliative value of radiation in these cases; furthermore, one finds an occasional case apparently cured or free from any evidence of the disease at the end of several years. However, the essential point of the paper is to emphasize, first, the value of radiation in the treatment of some chondrosarcomas.

About two years ago, at a meeting of the American Roentgen Ray Society, I read a preliminary report on the results obtained at that time in the treatment of some giant-cell tumors. With the exception of two cases, all of those considered in that report have continued to improve or have remained free of any signs of recurrence or presence of actively growing tumor. One case developed a recurrence, but, on treatment, has responded favorably and the condition at this time is quite satisfactory. Another case was treated under a mistaken diagnosis and came to amputation. This tumor, when examined in the laboratory, was found to be lacking in many of the essential features of a giant-cell tumor and resembled considerably what Ewing terms as a telangiectatic sarcoma. This patient is alive and well to-day with no evidence of the disease present. It may be well to state here that, though we do not recommend pre-operative radiation in malignant bone tumors as a routine procedure, we have instances where the long-continued use of radiation prior to amputation seemed to be a factor in preventing metastases to the lungs. The use of radiation in these cases was followed by the production of much fibrous tissue, complete or partial encapsulation of the tumor by fibrous tissue or bony material, and necrosis or degeneration of large areas of the tumor.

It should be emphasized that the greatest value of radiation in the treatment of giant-cell tumor appears to be in those cases where the tumor has so destroyed the end of a weight-bearing bone that the logical procedure is amputation. It is obvious that the value of a simple curettement in such cases lies only in the ability to completely remove the tumor. This frequently cannot be or is not accomplished.

If, however, the tumor is completely removed, a shell-like cavity remains, so fragile that the limb is of no value for weight-bearing purposes. A number of such cases have been followed for a considerable period and it was only after a lapse of years that we have been able to demonstrate in the radiographs the production of any considerable quantity of new bone. Furthermore, the hazards of infection or destruction of the joint surfaces in such cases are

considerable. Of course, there are numerous instances in which the curettement of a small tumor limited to a condyle and surrounded by considerable healthy bone is the logical treatment, but even in these instances, it is doubtful if radiation cannot accomplish as much as curettage in the relief from pain and saving of time in restoring the limb to usefulness, considering the subsequent rest and use of splints and braces, which are necessary for a long period. In such cases the time factor of disability is probably as important as any other, and it is doubtful if a greater loss of time is occasioned through roentgen therapy than that resulting from curettement.

We are able to present four knee-joint cases in which amputation would have been the logical method of treatment. In these cases the tumors had so destroyed the ends of the bones that curettage was out of the question. All of these cases are at the present time apparently free from any evidence of tumor, the area involved being strongly ossified, with but little limitation in motion. I have seen these cases within the past month, and they are all engaged in earning a livelihood at strenuous occupations.

In conclusion, I want to state that it is realized that in this group of giant-cell tumors there are many variations in the histological--and consequently the clinical and roentgenographic—features. The age of the patient and the location of the tumor, as well as the histology, size and extent of the growth, are extremely important factors in determining the character of the treatment.

Resection of the tumor and the use of a bonegraft may, in a middle-aged person with a tumor in the distal end of the ulna or proximal end of the fibula, be the logical procedure, and curettage of a small tumor in the end of a weight-bearing bone in a middle-aged or even young adult is no doubt frequently successful and the rational method of treatment. As for amputation, I believe that this procedure should be limited to those cases in the elderly or middle-aged where the location and extent of the tumor is such that regeneration of bone, or, rather, production following curettage or radiation, will not be sufficient in quantity to restore the limb to usefulness. It is the belief now at the Memorial Hospital, as a result of the observation of a large number of cases of giant-cell tumors of bone treated by radiation alone during the past five or six years, that in most instances the results warrant a trial of radiation therapy before resorting to curettage or amputation. And especially is this the belief in the cases of young adults and children, where the results have been most gratifying. Given a young adult with a giant-cell tumor in the distal end of the femur or upper end of the tibia of such size and extent that amputation is the only other method of treatment advised,—in such an instance radiation (in the majority of cases) demonstrates definitely its great value in the treatment of a medullary bone tumor.

SOLITARY DIVERTICULUM OF THE JEJUNUM [1]

REPORT OF A CASE DIAGNOSED ROENTGENOLOGICALLY

By HAROLD SWANBERG, B.Sc., M.D., F.A.C.P., and E. B. MONTGOMERY, M.D., F.A.C.S., QUINCY, ILLINOIS

THE basis for this paper is the desire to place on record an instance of the rare condition of a solitary diverticulum of the upper jejunum: we have diagnosed it roentgenologically, although that diagnosis has not yet been confirmed by operation.

Diverticula of the jejunum are of rare occurrence, being the least frequent diverticula of any portion of the gastro-intestinal tract. Such diverticula may be single or multiple, although the multiple variety are about twice as frequent in occurrence. Rothschild (4), in 1925, in a review of the literature up to that time, was able to record only 33 reported cases of diverticula of the jejunum, nearly all of which were discovered at necropsy or operation.

Case (1), in 1920, was the first to record having successfully diagnosed diverticula of the jejunum roentgenologically. He reported five cases of diverticula of the jejunum, two of which were operated upon and the diagnosis confirmed. "In the other three, findings were so characteristically similar that no reasonable doubt could exist as to the diagnosis, but operative proof was not obtained." (1) It is noteworthy that all of the cases reported by Case were multiple diverticula. The first case of a single diverticulum of the jejunum to be reported as diagnosed roentgenologically was by Cook (2), in 1921. His case was confirmed by operation. The second such case to be reported as diagnosed roentgenologically was by Baastrup (3), in 1924. This case was also confirmed by operation. The third case was by Rothschild (4), in 1925, which has also been confirmed by operation. We believe the case we are about to record represents the fourth case of a solitary diverticulum of the jejunum to be reported as being recognized roentgenologically. It is interesting to note that in all four of these cases diagnosed roentgenologically, the diverticulum occurred in the extreme upper portion of the jejunum. Other radiologists have, no doubt, diagnosed cases of solitary diverticulum of the jejunum, but a careful review of the literature does not reveal additional cases being reported.

Fig. 1. Roentgenogram taken immediately after partaking of barium meal, showing the jejunal diverticulum simulating a possible diverticulum on the greater curvature of stomach (Aug. 10, 1925).

REPORT OF CASE

Mrs. M. B., aged 55, a widow, was referred by Dr. E. B. Montgomery, of Quincy, on August 10, 1925, for a gastro-intestinal X-ray examination at Blessing Hospital, Quincy, with the following history:

The patient first consulted her physician in regard to the present illness on February 28, 1925. She gave an indefinite history of stomach disturbance lasting for several years for which domestic remedies had

[1] Read before the Radiological Society of North America, at Cleveland, December 8, 1925.

been chiefly used. Lately she had had intermittent vomiting and more or less constant pain and tenderness in the epigastrium. Her symptoms pointed to a gastric ulcer, and the Sippy method of treatment

Fig. 2. Roentgenogram taken forty-eight hours after the one shown in Figure 1, showing jejunal diverticulum.

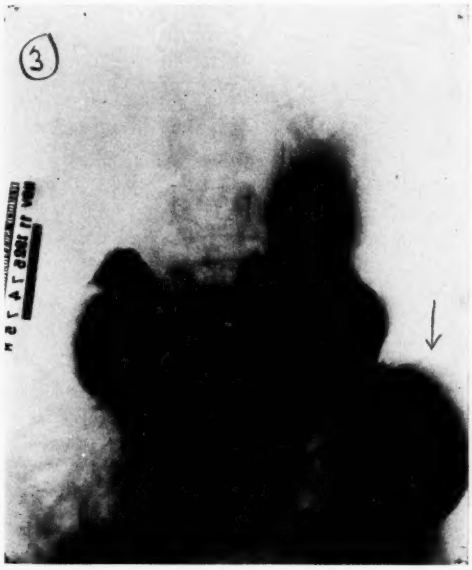

Fig. 3. Roentgenogram taken immediately after partaking of barium, showing jejunal diverticulum (Nov. 11, 1925).

by milk diet and alkalies was used, with some amelioration of symptoms. These continued to recur from time to time until July 21, 1925, when she began to vomit incessantly, retaining no food or drink, and no bowel movements occurred with either saline cathartics or high enemata, the latter returning uncolored. In consultation, Dr. H. J. Jurgens, of Quincy, agreed that the obstructive symptoms were probably due to a carcinoma of the lower colon, as a mass pressing there could be felt both by vaginal and rectal examination. It was decided to do a laparotomy and deal with the obstruction as became necessary. On July 24, 1925, an abdominal section was made, revealing a small fibroid of the fundus uteri, which was the mass simulating the colonic tumor. There was, however, a retro-cecal adherent appendix, which was removed. The gall bladder appeared normal, as did the stomach excepting general fullness of the blood vessels and the presence of one or two small glands in the mesentery. The abdominal wound was closed without drainage; it united by primary intention. The patient's vomiting continued, although several small bowel movements appeared following the operation. August 2, following a prolonged vomiting and retching, the abdominal wound reopened, with expulsion of intestines and omentum. These were replaced and the abdominal wound reclosed, but the vomiting still continued, only, however, at 48-hour intervals. The vomitus consisted of a clear bile-stained fluid to the amount of 16 to 24 oz. each time. The patient took more nourishment, growing much stronger, had regular bowel movements, but her vomiting continued at 48-hour intervals as before.

Due to the fact that there was still periodic vomiting and that the cause had apparently not been discovered at operation, an X-ray examination was ordered, with the following results:

We found an emaciated patient, very

weak, and unable to stand or sit up, convalescing from the second operation, a week before. A barium meal was given, but, due to the abdominal wound, the fluoroscopic examination could be made only in the prone position. The meal readily entered the stomach and began to empty

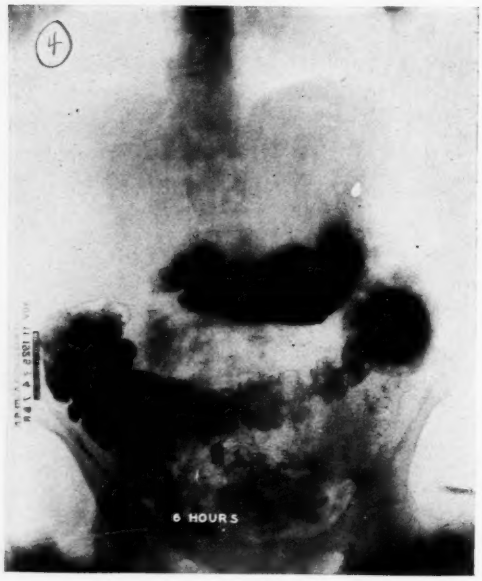

Fig. 4. Roentgenogram taken six hours after the one shown in Figure 3, showing jejunal diverticulum.

at once, giving an appearance similar to that in which a large gastro-enterostomy has been done. The films showed a normal gastric contour except on the greater curvature, in its middle part, where there appeared to be a distinct, large bulging, as if a diverticulum were present. The sacculation was nearly oval, measuring about 6 cm. in its greatest diameter. At six hours the head of the meal was in the transverse colon and a small gastric residue was seen, in addition to the above-mentioned sacculation, which still contained barium. At 24 and 48 hours barium was scattered throughout the colon, but the same sacculation reported above still contained barium. We felt that we were probably dealing with a large diverticulum on the greater curvature of the stomach but were not sure of our finding, due to the fact that all the films we had been able to secure were made in the prone position. (The condition of the patient was such that she could not sit up or be turned on her side because of pain, weakness and fear of another abdominal rupture.)

In the meantime the patient continued to improve. After about August 23 she took more nourishment and of a greater variety and was free from either nausea or vomiting until about September 24, since which time she has ejected 10 to 14 oz. of bile-stained fluid every fourth or fifth day. In the interval, repeated attempts were made to have the patient submit to another roentgen examination in order that views of the stomach might be obtained in various positions. The patient at first refused to co-operate, but finally, on November 11, a second examination was made, with the following observations:

In the vertical position, under the fluoroscope, the meal was seen to fill up the entire stomach normally, the contour being quite regular. The stomach began to empty at once, the duodenal bulb being very regular in outline. The meal passed readily through the second, third and fourth portions of the duodenum, all of which appeared normal. Immediately after entering the jejunum a large rounded sacculation of barium, size about 8.5 cm. in diameter, appeared just below the level of the greater curvature of the stomach. Films made at different angles confirmed this observation and showed that the large sacculation was not connected with the stomach, but posterior to it, presumably connected with the jejunum. A 6-hour examination showed the head of the meal in the splenic flexure, but there still remained a fair sized gastric residue and the large dilated sacculation in the jejunum was filled with barium. In fact, the sacculation appeared somewhat larger and the 6-hour gastric residue greater than at the examination three months before.

From the above roentgenologic findings and clinical history we feel confident that

we are dealing with a large diverticulum of the beginning portion of the jejunum. According to Rothschild, these jejunal diverticula are most frequently observed in individuals past fifty and the symptoms may be acute or chronic, but no definite symptom-complex can be attributed to their presence. The acute symptoms are usually those of an acute intestinal obstruction such as our case had. The chronic cases usually complain of loss of weight, abdominal pain and some constipation.

The importance of establishing a correct diagnosis in these cases, which can be done only roentgenologically, is due to the fact that the treatment, which is surgical, offers a specific cure. In our case we have been unable to persuade our patient to submit to a third operation. This is indeed most unfortunate, especially in view of the fact that there is every indication that the clinical diagnosis has now been correctly established, and surgery would be almost sure to afford complete and permanent relief from all symptoms.

Such a case as this illustrates the advisability of submitting practically all cases of suspected intestinal obstruction to a careful X-ray study before operation, if the condition of the patient permits such a procedure. The roentgenologist can usually furnish fairly definite data as to the site of the supposed obstruction, which will save the surgeon much valuable time by directing his attention immediately to the proper anatomical part. That the surgeons did not find a diverticulum of the jejunum at the time of operation in this case does not exclude the condition. LeWald, in discussing Case's paper mentioned above (1), warns about the surgeon's difficulty in confirming such diagnoses. It is necessary that the whole length of the jejunum be carefully followed and inspected minutely. This, of course, is not usually done, for such diverticula are so rare that, unless previously diagnosed roentgenologically, they are, as a rule, not suspected or even thought of.

COMMENT BY DR. E. B. MONTGOMERY

This case, of which Dr. Swanberg has made such a careful roentgenological study under adverse conditions, seems to show the importance of collaboration of the physician and the roentgenologist in all obscure gastro-enteric conditions. I have had occasion to know its value in the diagnosis of intestinal obstruction due to diverticulitis of the colon, but this case illustrates the possibility of acute obstruction resulting from a jejunal diverticulitis. This case was one in which by physical examination the cause of obstruction seemed plainly due to a carcinoma of the colon, and it is doubtful whether any roentgenological study we could have been able to make in this acute condition would have thrown any additional light on the subject. This diverticulum was overlooked at operation, probably because we were not looking for it and the condition of the appendix seemed to account for the symptoms. In the second of two cases reported by Cook and Hunt (2), an adherent appendix seemed to account for the symptoms. The patient died following operation for its removal and the jejunal diverticulum was discovered only at autopsy. Our patient has made a comparative recovery, *i.e.*, she has regained her weight and strength so that she has resumed her usual household duties. At this writing (Dec. 5, 1925), she suffers only some distress in the left hypochondrium, and some vomiting at 5- to 7-day intervals. From the surgical experience gathered from a very complete review of all reported cases by Rothschild (4), those cases in which a gastro-enterostomy has been done have been completely relieved. My patient has been informed of the prospect of relief by operation, and this may be done at a later date.

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DISCUSSION

Dr. L. T. LeWald (New York): I think these two contributions[1] are of great interest. First, in Dr. Swanberg's case, the diverticulum of the jejunum is one of the largest I have seen recorded. But the mere presence of the diverticulum is not the only thing to consider. I believe that he is correct in his statement that the diverticulum in this case, in view of the long retention of material in it, is a source of trouble, and I think that is perhaps the important thing to study in various diverticula as we find them.

In regard to other cases of diverticula of the small intestine, I am sure Dr. Case has some that he has not demonstrated, and Dr. Cole I know had a case of multiple diverticula of the small intestine.

In regard to family diverticulosis of the colon, reported by Dr. Mackoy, I am able to confirm this observation at the present time. I have a patient who had her colon resected for supposed carcinoma and she made such a brilliant recovery after a number of years that she wished to have her colostomy closed, if possible, and I was called upon to study the remainder of the lower portion of the sigmoid. Unfortunately, she had one of the very short sigmoids, so there was not sufficient material to properly close her colon defect, and she has had to carry her colostomy throughout some fifteen years. X-ray examination demonstrated, at the time I was called upon to see if she could have her colostomy closed, a number of diverticula higher up on the left side, and in looking up the history of her operation, it was determined that the resected specimen *failed to show evidence of carcinoma.* She is about 70 years of age. Just before I came to this meeting, her son asked me if I would examine his colon, and, curiously enough, he shows retention of material in the haustrations of his colon after 48 hours in such a way as to indicate that he is probably developing diverticula. I think it throws some light on the subject.

I have examined a great many children and have failed to find diverticula in them. One or two cases have been reported of diverticulitis in fairly young subjects, however.

I think one of the questions of importance in diverticula of the colon is in regard to the relation to toxic absorption. It depends, I believe, on the length of time that material is retained in the pockets. I have recorded two cases, one in which the material was retained 52 days, and another, in which it was retained 96 days. In each of these instances, by the way, the retention was in the hepatic flexure, and in one case a definite diagnosis of cholecystitis had been made by a surgeon. The patient is still keeping his gall bladder, since we found the presence of diverticula in the colon. Dr. Mackoy suggested that a differential diagnosis between diverticulitis and gall-bladder disease is very important. My suggestion is that in this case *diverticulitis on the right side* is causing the symptoms and is entirely independent of any gall-bladder trouble.

Dr. Swanberg (closing): Of course my paper is a preliminary one, due to the fact that we have not confirmed the diagnosis by operation. It is difficult to induce a patient to submit to three operations within three months. Most of these single diverticula, according to the literature on the subject, occur on the mesenteric attachment of the bowel and are difficult to see at operation. Just before I left for this meeting, I handed my paper to the surgeon who operated on this patient, and his comments are incorporated with the paper (see page 147).

[1] No paper has been received for publication from Dr. F. W. Mackoy, of Milwaukee, Wisconsin. —EDITOR.

AN INDEXING SYSTEM FOR THE CATALOGUING OF PATHOLOGICAL FILMS [1]

By L. R. SANTE, M.D., F.A.C.P., F.A.C.R., Associate Professor of Radiology, St. Louis University Medical School

WHETHER the quantity of work in an X-ray laboratory is large or small, some ready reference system for the pathological films in the general file is a great advantage.

The cross-indexing of pathological conditions encourages comparison and study, and tends to improve the diagnostic ability of the radiologist. Such a system must not be too cumbersome nor expensive, and it must be very elastic, permitting a wide variation in the classification of diseases and conditions and allowing ample opportunity for the adoption of personal ideas.

None of the classifications of diseases, or causes of death, in general use, can be used for an X-ray classification, since they are not adapted to a wide range of conditions. Many classifications, for instance, group all fractures under the various agencies by which they were produced, *i.e.*, automobile accidents, railroad accidents, etc. The radiologist cares little about the agency producing the injury; his desire is to obtain a classification of the types of pathology present. The Bellevue classification, the United States Government classification, and most other classifications name only diseases and leave no place for the introduction of symptoms or pathological signs.

The present classification takes into consideration not only disease conditions, but pathological signs or symptoms, and may be modified to include any special investigation desired by the individual radiologist. The system is, in brief, a modification of the Dewey Decimal System applied to radiologists' needs.

The various anatomical systems are all numbered. All diseases or pathological conditions are grouped under the various systems wherever they belong, and are numbered with decimals. Each number, with the disease condition which it represents, is placed upon a card and records of all cases of this disease are entered upon this card. Either the patient's name or case number may be entered, provided the case number system is in general use.

The films remain in the general file, this indexing system merely giving information as to where they may be found. If any new condition, not covered in the file, is encountered, which the radiologist wishes to investigate, a new number is added and the remainder of the system is not disturbed.

At the end of the five-year period, when the negative films will no longer be of use, these films can be taken out and put in boxes labeled with the disease numbers; in this way a catalogue of films can be built up.

The cards are kept in any type of convenient indexing system. Details of the classification suggested as a groundwork upon which to build the system best adapted to the needs of each individual are given below:

0. Skeletal System.
1. Sinuses, Paranasal, and Mastoids.
2. Teeth.
3. Muscular System.
4. Circulatory System, Blood Vessel Mapping.
5. Lymphatic System.
6. Nervous System, Ventriculography, Lipiodol Injection in Spinal Canal.
7. Cutaneous

[1] From the X-Ray Department of the St. Louis City Hospital.

8, 9, and 10. Digestive
11 and 12. Respiratory
13. Endocrine System.
14. Urinary Tract, Pyelography.
15. Generative Organs.
16. Pneumoperitoneum.

0. SKELETAL SYSTEM

0. Normal Bones

FRACTURES

0.0 FRACTURES
0.00 Skull
0.000 Parietal region
0.0001 Parietal region extending into base
0.001 Frontal region
0.0010 Frontal region extending into sinuses
0.002 Occipital region
0.0020 Occipital region extending into foramen magnum
0.003 Basal region
0.004 Showing depression
0.005 Diastatic (if fractures are depressed add 0.004)
0.006 Decompression

FRACTURES

0.01 BONES OF FACE AND JAW
0.010 Nose
0.011 Zygomatic arch
0.012 Maxilla-antrum
0.013 Palate
0.014 Mandible
0.0140 [illegible] symphysis
0.0141 [illegible] angle
0.0142 [illegible] body
0.0143 [illegible] ramus
0.0144 [illegible] condylar process
0.0145 [illegible] coronoid process

0.02 FRACTURES OF THE SPINE
0.020 Cervical Spine
0.0201 First cervical
0.02010 Through ring of vertebra
0.02011 Articular process
0.0202 Second cervical
0.02020 Odontoid process
0.0203 Remaining cervical spine
0.02030 Compression fracture
0.02031 Fracture of process
0.02032 Forward displacement of head and upper vertebræ

0.021 Dorsal Spine
0.0210 Compression fracture
0.0211 Other fractures
0.0212 With lateral displacement
0.0213 Pressure on cord

0.022 Lumbar Vertebræ
0.0220 Compression fracture
0.0221 Spinous processes
0.0222 Transverse processes
0.0223 Articular processes
0.0224 Lateral displacement
0.0225 Pressure on cord

FRACTURES

0.023 Fracture of Sacrum
0.0230 Involving sacro-iliac joint
0.024 Coccyx
0.03 Thorax
0.030 Ribs
0.031 Sternum

0.04 Fracture of Pelvis
0.040 Through ramus of pubis

	0.041	Through ramus of ischium
	0.042	Through iliac bones
	0.043	Acetabulum
FRACTURES	0.05	Upper Extremity
	0.050	Scapula
	0.0500	Inferior angle
	0.0501	Body
	0.0502	Acromion process
	0.0503	Coracoid process
	0.0504	Glenoid
	0.051	Fractured Clavicle
	0.0510	Inner third
	0.0511	Middle third
	0.0512	Outer third
	0.052	Fractured Humerus
	0.0520	Anatomical neck
	0.0521	Greater tuberosity
	0.0522	Surgical neck
	0.0523	Lesser tuberosity
	0.0524	Upper third of shaft
	0.0525	Middle third of shaft
	0.0526	Lower third of shaft
	0.0527	Supracondyloid
	0.0528	"Y" fracture into joint
	0.0529	Either epicondyle
FRACTURES	0.053	Fractured Radius
	0.0530	Head
	0.0531	Neck
	0.0532	Upper third of shaft
	0.0533	Middle third of shaft
	0.0534	Lower third of shaft
	0.0535	Colles' fracture
	0.05350	Colles' fracture with impaction
	0.05351	Colles' fracture in good position
	0.05352	Colles' fracture in poor position
	0.05353	Colles' fracture with palmar displacement
	0.05354	Colles' compression fracture as seen in children
	0.05356	Barton's fracture
	0.054	Fractured Ulna
	0.0540	Olecranon process
	0.0541	Coronoid process
	0.0542	Upper third of shaft
	0.0543	Middle third of shaft
	0.0544	Lower third of shaft
FRACTURES	0.055	Fractured Wrist
	0.0550	Scaphoid
	0.05500	Transverse, without displacement
	0.05501	Transverse, with displacement
	0.05502	Tuberosity
	0.0551	Semilunar
	0.0552	Cuneiform
	0.0553	Pisiform
	0.0554	Trapezium
	0.0555	Trapezoid
	0.0556	Os magnum
	0.0557	Unciforme
FRACTURES	0.056	Fractured Metacarpals
	0.0560	Bennett's fracture
	0.057	Fractured Phalanges
	0.058	Fractured Sesamoid
	0.06	Lower extremity
	0.060	Fractured Femur
	0.0600	Neck

	0.0601	Greater trochanter
	0.0602	Lesser trochanter
	0.0603	Intertrochanteric
	0.0604	Upper third of shaft
	0.0605	Middle third of shaft
	0.0606	Lower third of shaft
	0.0607	"Y" fracture into joint
	0.0608	Inner condyle
	0.0609	Outer condyle
FRACTURES	0.061	Fractured Tibia
	0.0610	Spine of
	0.0611	Condyle of
	0.0612	Tuberosity of
	0.0613	Upper third of shaft of
	0.0614	Middle third of shaft of
	0.0615	Lower third of shaft of
	0.0616	Inner malleolus
	0.062	Fractured Fibula
	0.0620	Upper third
	0.0621	Middle third
	0.0622	Lower third
	0.0623	Pott's fracture
FRACTURES	0.063	Fractured Patella
	0.0630	Transverse
	0.0631	Longitudinal
	0.0632	Stellate
	0.064	Fractured Tarsal Bones
	0.0640	Astragalus
	0.06400	Neck of
	0.0641	Os calcis
	0.06410	Through body of os calcis
	0.06411	Sustentaculum tali
	0.06412	At Achilles tendon attachment
FRACTURES	0.0644	Fractured Inner Cuneiform
	0.0643	Fractured Cuboid
	0.0642	Fractured Scaphoid
	0.0645	Middle cuneiform
	0.0646	Outer cuneiform
FRACTURES	0.065	Fractured Metatarsal
	0.0650	Proximal end of fifth
	0.066	Fractured Phalanges
	0.067	Sesamoid of great toe
	0.07	Gunshot fractures, all types
	0.08	Bone plate
DISLOCATIONS	0.1	Dislocations
	0.10	Spine
	0.100	Cervical
	0.1000	Head of first cervical
	0.1001	First cervical on second
	0.1002	All other dislocations of cervical spine
	0.101	Dorsal Spine
	0.102	Lumbar Spine
	0.103	Spondylolisthesis
	0.104	Dislocation of Coccyx
	0.11	Ribs
	0.110	At spinal attachment
	0.111	At sternal attachment
	0.12	Sacro-iliac Dislocation
	0.13	Symphysis pubis
DISLOCATIONS	0.14	Upper Extremity
	0.140	Sternoclavicular Articulation
	0.141	Acromioclavicular Articulation

	0.142	Shoulder Joint
	0.143	Elbow Joint
	0.144	Radio-ulnar Joint, superior
	0.145	Inferior
	0.146	Wrist Joint
	0.1460	Semilunar
	0.1461	Simple palmar
	0.1462	Simple lateral
	0.1463	Palmar rotation
	0.1464	Scaphoid
	0.1465	All other dislocations of wrist
	0.147	Metacarpals
	0.148	Phalanges
DISLOCATIONS	0.15 and 0.16	Lower Extremities
	0.150	Hip Joint
	0.151	Knee Joint
	0.1510	Semilunar cartilage
	0.152	Patella
	0.153	Tibio-fibular Articulation, superior
	0.154	Tibio-fibular Articulation, inferior
	0.155	Ankle Joint
	0.156	Astragalo-scaphoid Articulation
	0.157	Astragalo-calcaneal Articulation
	0.158	All other dislocations of tarsus
DISLOCATIONS	0.159	Metatarsals
	0.160	Phalanges
EPIPHYSEAL SEPARATIONS	0.2	Normal Epiphyses
	0.20	Spine
	0.21	Thorax
	0.210	Ribs
	0.211	Sternum
	0.22	Pelvis
	0.23	Upper Extremity
	0.230	Clavicle
	0.231	Scapula
	0.232	Humerus, upper end
	0.233	Lower end
	0.2330	Capitellum
	0.2331	Trochlea
	0.2332	Internal condyle
	0.2333	External condyle
	0.234	Radius, upper end
	0.235	Lower end
	0.236	Ulna, upper end
	0.237	Lower end
	0.238	Metacarpals
	0.239	Phalanges
	0.24	Lower Extremity
	0.240	Femur
	0.2400	Head
	0.2401	Greater trochanter
	0.2402	Lesser trochanter
	0.2403	Lower end
	0.241	Tibia
	0.2410	Upper end
	0.2411	Lower end
	0.242	Fibula
	0.2420	Upper end
	0.2421	Lower end
	0.243	Os calcis
	0.244	Metatarsals
	0.245	Phalanges
ABNORMAL DEVELOPMENTS AND ANOMALIES	0.3 and 0.4	Abnormal developments and anomalies
	0.30	Skull (dolichocephalic, etc.)
	0.300	Anencephaly
	0.301	Meningocele
	0.31	Face
	0.32	Spine

	0.320	Cervical
	0.321	Dorsal
	0.322	Lumbar
	0.3220	Sacralization
	0.3221	Spina bifida
	0.323	Sacrum
	0.324	Coccyx
	0.33	Anomalies, Thorax
	0.330	Cervical rib
	0.331	Synosteosis
	0.332	Accessory ribs
	0.333	Lumbar rib
	0.334	Sternum
	0.34	Pelvis
	0.35	Upper Extremity
	0.350	Humerus
	0.351	Scapula, Sprengel's deformity
	0.352	Clavicle
	0.353	Radius
	0.354	Ulna
	0.355	Carpus
	0.356	Metacarpals
	0.357	Phalanges
	0.36	Lower Extremity
	0.360	Femur
	0.361	Patella
	0.362	Tibia
	0.363	Tarsal
	0.3630	Pes planus
	0.364	Metatarsal
	0.365	Phalanges
	0.4	Dystrophies
	0.40	Osteogenesis imperfecta
	0.41	Osteomalacia
	0.42	Acromegalia
	0.43	Amputation—congenital
	0.44	Foreign body in bone
DISEASE OF BONE	0.5	Disease of bone
	0.50	Infections
	0.500	Pyogenic
	0.5000	Osteomyelitis
	0.50000	Superficial type
	0.50001	Deep type
	0.500010	Deep type, with sequestration
	0.500011	Cloaca formation
	0.50002	Brodie's abscess
	0.50003	Bone abscess
	0.50004	Acute, non-tuberculous epiphysitis
	0.50005	Pyogenic infectious periostitis
	0.501	Syphilis
	0.5010	Syphilitic osteomyelitis
	0.5011	Syphilitic dactylitis
	0.5012	Syphilitic gumma
	0.5013	Syphilitic epiphysitis
	0.5014	Syphilis, congenital
	0.5015	Syphilitic periostitis
DISEASE OF BONE	0.502	Tuberculosis
	0.5020	Tuberculosis of shaft
	0.5021	Tuberculosis (kissing sequestra)
	0.5022	Tuberculous spondylitis
	0.5023	Tuberculous synovitis
	0.5024	Tuberculous epiphysitis
DISEASE OF BONE	0.51	Unknown origin
	0.510	Perthes' Disease
	0.5100	Perthes' Disease
	0.511	Paget's Disease
	0.5110	Skull
	0.5111	Long bones

	0.512	Osteitis fibrosa cystica
	0.513	Hemihypertrophy
	0.52	Bone disease of nutrition and metabolism
	0.520	Rickets
	0.521	Scurvy
	0.522	Atrophy
	0.5220	Atrophy of quantity
	0.5221	Atrophy of quality
	0.523	Gout
	0.524	Radiation necrosis
	0.525	Osgood-Schlatter's disease
TUMORS OF BONE	0.6	Bone Tumors
	0.60	Benign
	0.600	Arising from cortex
	0.6000	Osteoma
	0.6001	Osteochondroma
	0.6002	Chondroma
	0.601	Arising from medullary canal
	0.6010	Bone cyst
	0.6011	Enchondroma
	0.6012	Giant-cell tumor (Bloodgood)
	0.6013	Hemorrhagic osteomyelitis (Barrie)
	0.6014	Non-suppurating (chronic) osteomyelitis (Bloodgood)
	0.61	Malignant Tumors
	0.610	Sarcoma
	0.611	Arising from periosteum (periosteal sarcoma)
	0.6110	Ossifying
	0.6111	Non-ossifying
	0.612	Arising from cortex (sclerosing sarcoma)
	0.613	Arising from medullary canal
	0.6130	Round-cell sarcoma
	0.61300	Slow-growing
	0.61301	Rapid-growing
	0.6131	Spindle-cell sarcoma
	0.61310	Slow-growing
	0.61311	Rapid-growing
	0.6132	Giant-cell sarcoma (malignant variety)
	0.6133	Myeloma (multiple)
	0.6134	Myeloid sarcoma
	0.614	Carcinoma
	0.6140	Osteoblastic type
	0.6141	Osteoclastic type
ARTHRITIS	0.7	Arthritis
	0.70	Infectious
	0.700	Septic
	0.701	Pyogenic
	0.7010	Pneumococcus Arthritis
	0.7011	Gonococcus Arthritis
	0.7012	Gonorrheal Spur, os calcis
	0.7013	All other pus-producing organisms
	0.702	Tuberculous Arthritis
	0.703	Syphilitic Arthritis
	0.7031	Charcot Spine
	0.71	Hypertrophic Arthritis
	0.710	Of spine
	0.711	Of other joints
	0.712	Spur, os calcis, hypertrophic
	0.713	Joint mice
	0.72	Atrophic Arthritis
	0.73	Pseudo-arthrosis
	0.78	Regeneration of bone
	0.79	Calcification of cartilages

1. SINUSES, PARANASAL, AND MASTOIDS

SINUSES

1.0 Paranasal Sinus
1.00 Anomalies
1.000 Frontal
1.001 Ethmoid
1.002 Antra
1.003 Sphenoid
1.01 Infections
1.010 Frontal
1.011 Ethmoid
1.012 Antra
1.013 Sphenoid
1.02 Granulations
1.020 Frontal
1.021 Ethmoid
1.022 Antra
1.023 Sphenoid
1.03 Tumors
1.030 Frontal
1.031 Ethmoid
1.032 Antra
1.033 Sphenoid

MASTOIDS

1.1 Mastoids, Normal
1.10 Diploetic type
1.11 Pneumatic type
1.12 Anomalies of
1.120 Zygomatic cells
1.121 Squamous cells
1.122 Occipital cells
1.13 Catarrhal Mastoiditis
1.14 Suppurative Mastoiditis
1.15 Sinus Thrombosis
1.16 Cholesteatoma

2. TEETH

TEETH

2.0 Crown
2.00 Fracture
2.01 Abrasion
2.02 Malocclusion
2.03 Pulp stone

2.1 Root
2.10 Fracture
2.11 Evulsion
2.12 Root amputation
2.13 Pulp stone
2.14 Apical resorption
2.15 Apical hypercementosis or exostosis
2.16 Apical ankylosis
2.17 Apical infection
2.170 Abscess, acute
2.171 Abscess, chronic
2.172 Abscess, lateral
2.173 Abscess, interradial

2.2 Peridental Membrane
2.20 Pyorrhea
2.21 Pericementitis
2.22 Secondary dentine
2.23 Canal resorption
2.24 Foreign body

2.3 Stratum Durham
2.30 Partial destruction
2.31 Complete destruction

2.4 Alveolar Process
2.40 Infections

	2.400	Granuloma
	2.401	Abscess, acute
	2.402	Abscess, chronic
	2.403	Osteomyelitis
	2.41	Cysts
	2.410	Inflammatory cysts
	2.411	Non-inflammatory cysts
	2.412	Odontoma
	2.42	Tumors
	2.420	Osteoma
	2.421	Eburnated areas
	2.5	Irregular Eruption of Teeth
	2.50	Misplaced
	2.51	Impacted
	2.52	Unerupted

3. MUSCULAR SYSTEM

MUSCLES	3.0	Myositis Ossificans
	3.1	Calcareous Deposits
	3.10	Calcified cysts
	3.11	Calcified hematoma
	3.2	Bursitis, swelling of bursa
	3.20	Calcareous deposit in bursa
	3.3	Foreign body in muscle

4. CIRCULATORY SYSTEM

HEART	4.1	Heart, Normal
	4.10	Enlargement of cardiac shadow
	4.100	Cardiac dilatation
	4.101	Cardiac hypertrophy
	4.1010	Mitral stenosis
	4.1011	Mitral regurgitation
	4.1012	Aortic stenosis
	4.1013	Aortic regurgitation
	4.1014	All other heart lesions
	4.102	Congenital heart disease
	4.11	Pericardial Effusion
	4.12	Cardiac aneurysm
	4.13	Calcified pericardium
	4.14	Pneumopericardium
	4.15	Foreign body in heart
	4.16	Detrocardia
BLOOD VESSELS	4.2	Blood Vessels
	4.21	Aneurysm, aortic
	4.210	Aneurysm, other arteries
	4.211	Arteriovenous aneurysm
	4.22	Aortitis
	4.23	Calcified aorta
	4.24	Arteriosclerosis
	4.25	Varicose veins
	4.26	Phleboliths
	4.27	Injection of vessels with opaque material

5. LYMPHATIC SYSTEM

LYMPHATICS	5.0	Enlarged Spleen
	5.00	Calcareous deposits in spleen
	5.1	Adenopathy of Lymph Glands
	5.10	Mediastinal
	5.11	Hilar
	5.2	Calcareous Lymph Glands
	5.3	Hodgkin's Disease and Other Lymphoblastoma
	5.4	Caseous Lymph Glands

6. NERVOUS SYSTEM

BRAIN	6.0	Brain and Meninges
	6.00	Tumors of brain, unassociated with X-ray findings
	6.01	Tumors of brain, associated with X-ray findings
	6.022	Meningioma
	6.003	Supersellar tumor
	6.004	Tumor of pituitary
	6.005	Tumor of auditory nerve
	6.01	Increase in Intracranial Pressure
	6.010	Convolutional atrophy
	6.011	Separation of sutures
SPINAL CORD	6.1	Spinal Cord and Meninges
	6.10	Meningocele
	6.11	Pressure on cord from fracture of spine, lipiodol
	6.12	Cord tumors, lipiodol demonstration
	6.2	Calcified falx cerebri
	6.3	Ventriculography

7. CUTANEOUS SYSTEM

SKIN	7.0	Calcareous deposits
	7.00	Calcareous deposits in nevi
	7.1	Tumors of soft parts
	7.2	Subcutaneous emphysema
	7.3	Foreign bodies
	7.4	Hematoma
	7.41	Caput succedaneum

8, 9, AND 10. DIGESTIVE SYSTEM

(INCLUDING LIVER AND GALL BLADDER, GENERAL ABDOMINAL CAVITY)

MOUTH	8.1	Mouth
	8.10	Salivary calculus
ESOPHAGUS	8.2	Esophagus
	8.21	Constriction of
	8.210	Constriction from caustic agents
	8.211	Constriction from carcinoma
	8.2110	Carcinoma, with rupture of
	8.212	Constriction from syphilis
	8.213	Constriction from spasm
	8.2130	Cardiospasm
	8.22	Diverticulum
	8.23	Foreign body in esophagus
STOMACH	8.3	Stomach
	8.30	Gastric ulcer
	8.301	Penetrating
	8.302	Sliding or burrowing
	8.303	Healed
	8.304	After operation
	8.31	Carcinoma, stomach
	8.310	Carcinoma, stomach, fundus
	8.311	Carcinoma, stomach, pars media
	8.312	Carcinoma, stomach, pars pyloric
	8.32	Linitis plastica
	8.33	Syphilis of stomach
	8.34	Spasm of stomach
	8.35	Hour-glass contracture
	8.350	Pressure defect, stomach
	8.36	Anomalies of stomach
	8.37	Foreign body in stomach
	8.38	Gastro-enterostomy
	8.39	Hematemesis
DUODENUM	8.4	Duodenal Deformity
	8.40	Duodenal ulcer

	8.400	Duodenal ulcer, ruptured
	8.41	Periduodenal adhesions
	8.42	Tumors of duodenum
	8.43	Duodenal diverticulum
	8.44	Pressure defect on bulb due to gall bladder
	8.45	Obstruction of duodenum
SMALL INTESTINE	8.5	Small Intestines
	8.50	Tumors of
	8.51	Obstruction of
	8.52	Intestinal adhesions
	8.53	Foreign body in small intestines
LARGE INTESTINE	8.6	Large Intestines
	8.60	Appendix, normal filling
	8.600	Residual barium
	8.601	Constrictions and malformations
	8.602	Retrocecal
	8.61	Cecum
	8.610	Inflammatory conditions of
	8.611	Tuberculosis of
	8.612	Tumors of, undetermined
	8.613	Carcinoma of
	8.614	Other neoplasms of
	8.615	Diverticulum
	8.616	Pressure defect
	8.62	Colon
	8.620	Inflammatory conditions of
	8.621	Tuberculosis of
	8.622	Tumors, undetermined
	8.623	Carcinoma of
	8.6230	Carcinoma, annular, of
	8.6231	Large filling defect of
	8.624	Other tumors of
	8.625	Diverticulosis and diverticulitis
	8.626	Malposition
	8.6260	Ptosis
	8.6261	Non-rotation of colon
	8.627	Enlargement
	8.6270	Megacolon
	8.628	Spasm of (spastic colon)
	8.629	Foreign body in colon
	8.63	Fistula of colon
	8.64	Rectum and Anus
	8.640	Carcinoma
	8.641	Syphilis
	8.642	Other constrictions
	8.643	Foreign body in rectum
LIVER, GALL BLADDER	9.1	Liver, any pathology of
	9.2	Gall bladder, ordinary examination
	9.20	Gall bladder, ordinary examination, pathological (without stones)
	9.21	Gall bladder, ordinary examination, pathological (with stones)
	9.22	Gall bladder, normal after tetraiodophenolphthalein injection
	9.23	Gall bladder, pathological after tetraiodophenolphthalein injection
	9.24	Gall bladder, normal after ingestion of tetraiodophenolphthalein
	9.25	Gall bladder, pathological after ingestion of tetraiodophenolphthalein
	9.26	Gall bladder, undissolved tetraiodophenolphthalein capsules
PANCREAS	9.3	Pancreas
	9.30	Cysts of
	9.31	Carcinoma of
ABDOMEN	10.	Abdomen—general cavity
	10.0	Abdominal Tumors
	10.01	Newgrowths
	10.02	Ascites
	10.1	Hernia of Abdomen
	10.10	Diaphragmatic
	10.11	Inguinal
	10.12	Umbilical
	10.13	Ventral
	10.14	All others
	10.2	Subdiaphragmatic Involvement

	10.20	Spontaneous pneumoperitoneum
	10.21	Abscess, subphrenic
	10.22	Subphrenic peritonitis

11. RESPIRATORY SYSTEM

PERIBRONCHIAL INCREASE	11.0	Peribronchial Increase
	11.00	Bronchitis
	11.01	Congestion
	11.02	Asthma
	11.021	Emphysema
	11.022	Irritant inhalation
	11.023	Pneumoconiosis
	11.024	Silicosis
	11.025	Siderosis
	11.03	Lymphatic Engorgement
LUNG CONSOLIDATIONS	11.1	Pneumonia
	11.10	Upper lobe lobar pneumonia
	11.11	Middle lobe lobar pneumonia
	11.12	Lower lobe lobar pneumonia
	11.13	Massive lobar pneumonia
	11.14	Resolving pneumonia
	11.2	Bronchopneumonia
	11.3	Hilus pneumonia
	11.4	Influenza
	11.40	Influenza pneumonia
	11.5	Lung Abscess
	11.50	Post-tonsillectomy
	11.51	Post-operative, otherwise
	11.52	Post-aspiration
	11.53	Exposure to cold
	11.54	Influenza
	11.55	Lobar pneumonia
	11.56	Bronchopneumonia
	11.57	Rupture of esophagus
	11.58	Unknown cause
	11.59	Septic pneumonia
	11.60	Chronic Diffuse Fibrosis (chronic interstitial pneumonia)
LUNG TUBERCULOSIS	11.61	Pulmonary Tuberculosis (Sanatorium Association Classification)
	11.62	Incipient
	11.63	Moderately advanced
	11.64	Far advanced
	11.65	Acute caseous tuberculous pneumonia
	11.66	Acute miliary
	11.67	Chronic miliary
	11.68	Healed miliary
	11.69	Bronchiectasis and chronic lung suppuration
	11.70	Infarct
	11.71	Syphilis
LUNG TUMORS	11.8	Tumors of Chest, primary
	11.80	Tumors of chest wall
	11.800	Sarcoma
	11.801	Endothelioma
	11.802	All other tumors
	11.81	Tumors of Chest Wall, secondary
	11.810	Carcinoma
	11.811	Sarcoma
	11.812	All other tumors
	11.82	Tumors of Lung, primary
	11.820	Carcinoma
	11.821	Sarcoma
	11.822	All other tumors
	11.83	Tumors of Lung, Secondary
	11.830	Carcinoma
	11.831	Sarcoma
	11.832	All other tumors
	11.84	Foreign bodies in lung or bronchi or upper passages

MEDIASTINUM	11.9	Mediastinum (enlargement of mediastinal shadow)
	11.90	Mediastinitis
	11.91	Mediastinal effusion
	11.92	Enlarged thymus (index also 13.30)
	11.93	Substernal thyroid
	11.94	Mediastinal newgrowths, primary
	11.940	Sarcoma
	11.941	Endothelioma
	11.942	All other tumors
	11.95	Enlargement of tracheobronchial lymph nodes
	11.950	Hodgkin's disease
LUNG INJURY	12.0	Injuries to Lung and Pleura
	12.00	Hemorrhage into lung
	12.01	Traumatic pneumonia
	12.02	Traumatic pleurisy
	12.03	Hemothorax
	12.04	Hemothorax, with pneumothorax
PLEURA	12.1	Lesions of Pleura
	12.10	Thickening of pleura (also calcified)
	12.11	Infectious pleurisy
	12.12	Pleural effusion (general)
	12.121	Empyema (general)
	12.122	Localized pleural effusion
	12.123	Between parietal and visceral pleura
	12.124	Interlobar
	12.125	Associated with plastic pleurisy
	12.13	Pneumothorax (with or without associated fluid)
	12.14	Atelectasis
	12.141	New born
	12.142	Extraneous pressure, rickets
	12.143	Massive collapse
	12.15	Fibrosis of lungs and pleura, chronic inflammatory
	12.151	Chronic interstitial pneumonia
	12.152	X-ray fibrosis from therapy

13. ENDOCRINE SYSTEM

PITUITARY	13.0	Pituitary
	13.00	Enlargement of sella turcica
	13.01	Tumors of, without calcification
	13.02	Tumors of, with calcification
	13.03	Calcification of pituitary
PINEAL	13.1	Pineal Body
	13.10	Tumors of, without calcification
	13.11	Tumors of, with calcification
	13.12	Calcification of pineal body
THYROID	13.2	Thyroid Gland
	13.20	Enlargement
	13.21	Enlargement, with pressure on trachea
	13.22	Calcified cysts of
	13.23	Substernal thyroid
	13.231	Displacement of trachea in
	13.24	Bony Epiphyses in Cretinism Due to Thyroid Pathology
THYMUS	13.3	Thymus
	13.30	Enlargement
	13.300	Enlargement, hyperplasia in infants
	13.301	Persistent thymus
	13.302	Tumors of, thymoma
ADRENAL	13.4	Adrenals
	13.40	Tuberculosis of (Addison's disease)
	13.41	Tumors of
	13.42	Pararenal emphysema, adrenal demonstrated
OVARY	13.5	Ovaries
	13.50	Cystic
	13.51	Tumors of

TESTICLE	13.6	Testicle
	13.60	Tumors of
	13.61	Tuberculosis of, with calcification

14. URINARY TRACT

(PYELOGRAM, URETEROGRAM, CYSTOGRAM)

KIDNEY	14.0	Kidneys
	14.00	Absence of kidneys
	14.01	Displacement
	14.02	Movable
	14.03	Enlargement
	14.04	Atrophy
	14.05	Tuberculosis
	14.06	Infarct of
	14.07	Tumors of
	14.070	Carcinoma
	14.071	Sarcoma
	14.072	Hypernephroma
	14.073	Polycystic kidney
URETER	14.1	Ureter
	14.10	Constriction of
	14.11	Dilatation of
	14.12	Kink
	14.13	Ureteral diverticulum
	14.14	Double ureter
	14.15	Ureteral calculus
BLADDER	14.2	Bladder
	14.20	Dilatation
	14.21	Contraction
	14.22	Calculus in
	14.23	Diverticulum of
	14.24	Tumors of
	14.240	Carcinoma
	14.241	All other tumors of
	14.242	Foreign bodies in
URETHRA	14.3	Urethra
	14.30	Stone in
	14.31	False passage in fistula, injected
	14.32	Foreign body in
PROSTATE	14.4	Prostate
	14.40	Enlargement
	14.400	Carcinoma
	14.401	Benign enlargement
	14.41	Prostatic stones

15. GENERATIVE SYSTEM

(INJECTION METHODS)

MALE	15.0	Male generative organs
	15.00	Penis, urethra (see also Urinary Tract)
	15.01	Seminal vesicles
	15.02	Vas deferens
	15.03	Testicle
	15.04	Epididymis
FEMALE	15.1	Female generative organs
	15.10	Vulva
	15.11	Vagina (and injection method)
	15.110	Hematocolpos
	15.12	Ureters
	15.120	Enlargement
PREGNANCY	15.121	Pregnancy
	15.1210	Cephalic presentation

15.1211 Breech
15.1212 Transverse
15.1213 All other abnormal presentations
15.1214 All other abnormal developmental conditions of fetus
15.1215 Twin pregnancy

15.122 Fibroid
15.123 All other tumors
15.124 Constrictions and abnormalities of cavity injection method
15.13 Fallopian tubes, injection method, air and lipiodol to determine potency

16. PNEUMOPERITONEUM

LIVER

16.0 Diseases of Liver
16.00 Cirrhosis
16.001 Carcinoma
16.02 Syphilis
16.03 Subdiaphragmatic abscess

SPLEEN

16.1 Spleen
16.10 Tuberculosis
16.11 Enlargement from malaria
16.12 Banti's disease
16.13 Splenomyelogenous leukemia
16.14 Malignancy of spleen

RETROPERITONEAL MASS

16.2 Retroperitoneal Mass
16.20 Disease of kidneys
16.21 Carcinoma
16.22 Sarcoma
16.23 Polycystic kidney
16.24 Misplaced kidney
16.25 Anomalies of kidney

16.3 Disease of Stomach
16.30 Ulcer
16.31 Carcinoma
16.32 Adhesions

16.4 Disease of Intestines
16.40 Adhesions
16.41 Hernia
16.42 Obstruction

16.5 Colon
16.50 Carcinoma
16.51 Adhesions

16.6 Generative Organs
16.60 Uterus
16.61 Tubes
16.62 Ovaries

16.7 Bladder and Ureters

16 8 Traumatic Rupture of Hollow Viscus

16.9 Spontaneous Pneumoperitoneum

FRONTAL SINUS AND MASTOID TECHNIC

By E. C. JERMAN, CHICAGO

Region	Position	K.V.P.	P.R.V.	Ma.	Distance	Time	Tube	Cone
Frontal Sinus, with Bucky.....	P.A.	87		10	25 in.	15	5–10 Rad.	5 × 10
Mastoid, with Bucky.....	Lat.	87		10	25 in.	5	5–10 Rad.	5 × 10
Frontal Sinus, without Bucky...	P.A.	74		10	30 in.	10	5–10 Rad.	3 × 7
Mastoid, without Bucky.....	Lat.	70		10	30 in.	5	5–10 Rad.	3 × 7

The P.R.V. (Pre-reading volt) column should be filled in following calibration of the machine to be used. This chart is based upon an average adult (150 pounds).

FRONTAL SINUS TECHNIC

A good radiogram of the frontal sinuses should show clearly and well defined the border walls and the septa of the sinuses. The frontal sinus area should be darkened slightly and should show a somewhat greater density than the surrounding bony structure. The ethmoid sinuses should be shown quite clearly. If the nose-chin position be used, the maxillary sinuses should be clearly outlined with proper density.

Equipment. — Double screens are ordinarily used for the purpose of obtaining more contrast with shorter exposure time. A cone 5 inches in diameter (at the larger opening) and 10 or 12 inches long is ordinarily employed when using the Potter-Bucky Diaphragm. A cone 3 inches in diameter (at the larger end) and 6 or 7 inches long is ordinarily employed when not using the Potter-Bucky Diaphragm, for the purpose of preventing secondary or stray radiation, so far as possible, from reaching the film. This secondary radiation produces what is ordinarily called "fog" and also interferes with sharpness of detail and lessens the contrast effect. Limiting the area of tissue exposed to the primary radiation by means of a cone, lessens the amount of secondary radiation delivered to the film.

An accurate measure of the time factor is essential in order that exposures may be continuously duplicated.

If a Potter-Bucky Diaphragm is used additional contrast may be obtained, but at the expense of detail and some magnified distortion.

A 5–10 radiator tube is suggested for this work. A 5–30 radiator, a fine focus universal, or a 5–100 radiator tube may be used, but the use of any of these will result in some sacrifice in the quality of detail.

The use of a stabilizer is suggested in order that the milliampere factor may be successfully duplicated.

A head rest of some sort will help materially in holding the head steady during time of exposure.

Technic. — With a Potter-Bucky Diaphragm a distance of 25 inches (the usual diaphragm distance) is suggested. Without a diaphragm, a 30-inch distance is suggested for the purpose of increasing the quality of detail.

Ten milliamperes is suggested in order that better detail may be obtained through the use of the smaller focal spot (the 5–10 radiator tube). If any one of the three larger capacity tubes (5–30, the universal, fine or the 5–100 radiator) be used, 20 milliamperes may be used by reducing the time of exposure to one-half, or 30 milliamperes may be used by reducing the time of exposure to one-third.

If the 5–10 radiator tube be employed it is suggested that the K.V.P. be fixed and

the time factor be made the variable factor for the purpose of controlling density. If either of the larger capacity tubes be employed, the time factor may be fixed and the K.V.P. factor made the variable factor.

Position of patient, tube and cassette.—Two frontal sinus positions are in common use. In the nose-chin position the patient lies face down on the cassette or Bucky Diaphragm, with chin resting firmly and nose elevated from ¼ to ⅓ inch. The head should be carefully centered so that the middle of a line from the center of one eye to center of other eye shall be placed directly over the center of the cassette. The central ray from the tube or the cone opening should then be centered to the cassette. In the nose-forehead position the nose and forehead rest firmly on the cassette, with the head carefully centered so that the middle of a line from center of one eye to center of the other eye shall be placed directly over the center of the cassette, with the central ray from the tube or the cone opening centered to the cassette. The immobilizing band, a head rest, or sand bags may assist in holding the head steady during time of exposure.

MASTOID TECHNIC

A good radiogram of a mastoid should show the complete lateral contour of the mastoid area as well as the complete cellular structure of this area. All septa should be clear and distinct.

Equipment.—The equipment should correspond with that outlined above for the frontal sinuses.

Technic.—The technic should correspond with that outlined above for the frontal sinuses.

Position of patient, tube and cassette.—The patient should be in a prone position with the desired mastoid area placed over the center of the cassette with the outer angle of the lower jaw parallel to the cassette and film and with the chin moved as far as convenient toward the chest. The tube and cone should be tilted downward (toward feet of patient) at an angle of about 12 degrees, with the central ray from the focal spot of the tube through the center of the cone opening directed toward the center of the cassette. Immobilization will assist materially in holding the head at rest during time of exposure.

CASE REPORTS AND NEW DEVICES

CONGENITAL DEFORMITY OF TRACHEA AND ESOPHAGUS: REPORT OF CASE

By R. MARK BROWN, M.D., Ogden, Utah

The patient was an infant 24 hours old. *Complaint:* Inability to swallow. Breast feedings regurgitated a few minutes after nursing began.

Fig. 1.

X-ray examination showed the retention of two drams of water and barium mixture, the lower level of the meal being opposite the fourth dorsal vertebra. The diagnosis of complete occlusion of the esophagus was made.

The following day the infant died. An autopsy showed that the barium mixture had reached the stomach, yet the pouch as shown on the X-ray film did not have an outlet. On passing a soft probe from the stomach upwards it was found that there was an opening into the trachea at the level of the fifth dorsal vertebra, and that the barium had reached the stomach by passing down through the vocal cords and the upper part of the trachea, through a congenitally formed passage into the lower part of the esophagus and then into the stomach.

The right hand was also deformed, as shown in the illustration to the left.

MALPOSITION OF CECUM AND ASCENDING COLON: CASE REPORT

By FRED S. O'HARA, M.D., Springfield, Illinois

The patient, a woman aged 45, weighing 150 pounds, came for roentgen-ray examination by direction of her family physician, for an obscure abdominal condition.

The blood picture was approximately

Fig. 1.

normal with the exception of a slightly high leukocyte count (10,000 odd). No pathology was discoverable by the X-ray until six hours had passed, at which time a screen examination yielded the information that the patient carried a cecum and ascending colon "upside down." (See Fig. 1.) After ingestion of the dye the gall bladder was found to be sufficiently suspicious to justify surgery being advised. At operation, a large biliary concretion was removed, and the malposition of the cecum and ascending colon was confirmed.

A SIMPLE METHOD OF PREPARING GELATIN CAPSULES OF TETRAIODOPHENOLPHTHALEIN

By BERNARD R. MOONEY, M.D.,
EDMONTON, ALBERTA

Hardening gelatin capsules over formaldehyde vapor for a certain length of time and filling them with tetraiodophenolphthalein is a method which has been used for some time, but the following procedure is so quickly and easily done and the results so uniformly better than any obtained by me before that I conclude others will be interested in trying it.

Size No. 2 gelatin capsule is packed with 8 grains of the dye, dipped in a 10 per cent solution of formaldehyde and allowed to become nearly dry (sticky) by exposure to the air. It is then enclosed in a larger sized capsule, a No. 0. Glutoid, formed by the action of formaldehyde on gelatin, becomes very insoluble if allowed to dry, hence the reason for covering the partly dried capsule with a larger sized dry one. The dipping very effectually seals the capsule. The capsules should be freshly prepared and exposed to the light as little as possible. Dose 20 to 40 grains, depending on the weight of the patient.

One capsule is taken every 15 minutes, starting at 6 P. M. the evening preceding the day the examination is to be made. The

Fig. 1. Case 1. Oral method as described in text. Gall bladder 15 hours after ingestion of dye.

Fig. 2. Same case as shown in Figure 1, showing pressure deformity of gall bladder on pyloric end of stomach 18 hours after ingestion of dye.

Fig. 3. Case 2. Oral method as described in text. Plate taken 15 hours after administration of tetra-iodophenolphthalein.

Fig. 4. Same case, at 18 hours.

Fig. 5. Same case, after a meal rich in fats. Plate taken at 20 hours; gall bladder empty.

patient is instructed to take a light, non-protein evening meal and drink plenty of water. Breakfast is omitted and plates are made at 15 and 18 hours after the ingestion of the dye. Following the 18-hour plate a meal, rich in fats, is taken, and plates made again in an hour or two to see if the gall bladder empties. If it is not empty or nearly so, the examination is continued at intervals until it is. This routine may be varied to suit the radiologist's convenience. Giving a barium meal while the gall bladder is full of the dye, at times shows beautifully the relation of this viscus to the surrounding structures.

I have carefully used "enteric" coated pills and capsules prepared by different commercial manufacturers, also tried having them put up by local chemists, and with a certain degree of success, but the important advantages of the method described, as I see them, are as follows:

1. The drug is fresh when administered. It is better to have the capsules prepared just an hour or two before taking.
2. The method is simple, takes only a few minutes, and can be done in the radiologist's office if advisable.
3. Nausea, vomiting and diarrhea are not so often noted. In the last 50 routine cases, nausea occurred five times, vomiting twice, and diarrhea not at all.
4. Gall-bladder shadows on the plates are uniformly better.

EDITORIAL

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EFFECT OF ROENTGEN-RAY THERAPY ON THE KIDNEY

As the science of radiology develops it becomes more evident that great skill and caution must be exercised in the application of high voltage roentgen rays. The radiologists and the medical profession in general are alive to the damage that may result from striking vital organs.

Fortunately, the depth dosage reaching a particular organ can be estimated with reasonable accuracy. Hence, if the amount of irradiation which can be safely absorbed by an organ is known, destructive doses may be avoided.

The susceptibility of the kidney to irradiation has been unsettled, due to conflicting evidence presented by various investigators. In 1905, Schultze and Hoffman demonstrated a chronic interstitial nephritis in rabbit kidneys several months after bringing the organs through a surgical incision to the skin surface and raying them directly. In 1907, Warthin warned that a dangerous exacerbation of nephritis might be excited by X-ray. The work of McQuarrie and Whipple, in 1922, in applying large doses over the kidney but through the body wall showed slight lowering of function for a few days but no histological alterations.

Martin, in 1924, while irradiating the adrenals through a surgical incision, accidentally irradiated the upper pole of one kidney and demonstrated marked interstitial changes.

In 1926 the method of Schultze and Hoffman was applied by O'Hare, Altnow, Christian, Calhoun and Sosman, with confirmation of the results mentioned above.

In the 1926 meetings of the American Medical Association and the American Roentgen Ray Society, Hartman, Bolliger and Doub presented exhibits showing the effect of deep irradiation on the kidneys of dogs when projected through the body wall. Thus the experimental conditions simulated X-ray therapy in man, and, although as much as three human erythema doses were used in some instances, a single human erythema dose was demonstrated to have produced fatal nephritides in young animals. The kidney lesions as presented were of the combined interstitial and vascular type but all structures were involved. In animals followed four months or more, there was not only almost complete replacement of the tubules by fibrous tissue but widespread sclerosis of the glomerular tufts, with marked thickening of Bowman's capsule.

From the functional standpoint the nephritis resembles chronic interstitial nephritis, with hypertension, in man, since marked nitrogen retention in the blood and gradually decreasing phenolsulphonephthalein excretion in the urine were demonstrated. Charted blood pressure readings showed slowly rising systolic and diastolic curves, with some of the systolic pressures reaching 180 to 230 mm.

Further, the last-named workers showed functional charts and blood pressure curves of a young man receiving deep therapy for lymphosarcoma, illustrating the development of a hypertensive nephritis which paralleled in every way the experimental production of kidney lesions and hypertension in their dogs.

The susceptibility of the kidney parenchyma and blood vessels to high voltage roentgen rays being demonstrated, along with the progressive nature of the lesions

when once initiated, makes it necessary to avoid the kidney area in so far as possible in treatment work. Particular caution should be exercised in determining kidney function before any deep therapy which might strike the kidneys is applied, and also throughout the course of such treatment, so that as much data as possible regarding clinical cases may be collected.

RUSSELL D. CARMAN

Russell Daniel Carman, M.D., F.A.C.R., F.A.C.P., was born in Iroquois, Ontario, March 18, 1875. While yet a small boy he was taken to Butte, Montana, whence, after a short residence, his parents moved to St. Paul, Minnesota. Here he attended the graded and high schools and the Minneapolis Academy. He took the pre-medical work of the University of Minnesota and was graduated as Doctor of Medicine at the Marion Sims-Beaumont Medical College of St. Louis, Missouri, in 1901.

In 1901 and 1902 he attended Johns Hopkins Medical School, Baltimore, Maryland, doing post-graduate work in orthopedics. During the Summer of 1903 he took special work in orthopedics at Harvard Medical College, returning to St. Louis in 1903 and entering practice.

He was Assistant in Surgery, 1902 to 1907; Assistant in Roentgenology, 1907 to 1909, and Assistant Professor of Roentgenology, 1909-1910, in Marion Sims-Beaumont Medical College. He was Lecturer in Roentgenology in Washington University Medical School, 1910 to 1913. January 1, 1913, he assumed charge of the Department of Roentgenology at the Mayo Clinic, Rochester, Minnesota, in which capacity he remained until his death. He was Professor of Roentgenology in the Mayo Foundation Graduate School, University of Minnesota.

At one time he was Lieutenant in the U. S. Medical Corps. During the World War he was a member of the Medical Examining Board in Rochester, Minnesota.

He was a member of the Olmsted County Medical Society, Minnesota Medical Society, American Medical Association, American College of Physicians, American College of Radiology (Past President), Radiological Society of North America (Past President), American Roentgen Ray Society (President-elect), International Congress of Radiology, Chicago Roentgen Society, Iowa X-ray Club, Roentgen Society of London, England, Nordisk Forening for Medicinsk Radiologi, Association of Resident and Ex-resident Physicians of the Mayo Clinic, Alpha Kappa Kappa, Sigma Xi, various Masonic bodies and the "Shrine."

He was married to Miss Sadie L. Butler, of St. Louis, Missouri, on November 14, 1904, and she survives him. He passed away in his beautiful home in Rochester, Minnesota, June 18, after a period of distressing illness, during which his morale was remarkable.

Dr. Carman was a careful observer and a close student of radiology, with rare ability to describe his observations. His contributions to the subject, especially as referred to the gastro-intestinal tract, were numerous and exceedingly valuable. Probably no one has added more to the subject of the radiology of the gastro-intestinal tract than he, and it seemed almost like the irony of fate that he should die of a disease of which he knew probably as much, from the radiological standpoint, as any man of his time.

As a man he was genial, courteous and sympathetic. He attracted men to him and he consequently had a very large circle of close friends who will miss his whole-souled, frank and kindly advice and counsel. Many of the younger radiologists of high rank and standing had been his pupils and protégés, and looked up to him as a guiding mentor and leader, a careful teacher and sincere friend. To the older radiologists he was always a considerate associate, a careful, constructive, fearless critic, and a lovable, indulgent and sincere colleague.

THE ANNUAL MEETING

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CHICAGO ROENTGEN SOCIETY

At the annual meeting of the Society the following officers were elected for the ensuing year: Edward S. Blaine, M.D., *President;* W. T. Bronson, M.D., *Vice-president;* Robert A. Arens, M.D., *Secretary-Treasurer.* The Executive Board consists of the following: E. L. Jenkinson, M.D., Benjamin H. Orndoff, M.D., and M. J. Hubeny, M.D.

THE COLLEGE OF RADIOLOGY

The annual meeting of the College of Radiology was held at Dallas, Texas, April 20, 1926.

The Board of Chancellors created nineteen new Fellowships, as follows: D. Y. Keith, E. C. Samuel, A. C. Heublein, Daniel D. Talley, B. H. Jackson, John D. MacRae, B. C. Cushway, W. I. LeFevre, Charles G. Sutherland, J. C. Dickinson, B. H. Nichols, LeRoy Sante, L. E. Pariseau, Walter C. Hill, John F. McCullough, Sidney C. Barrow, Charles D. Enfield, Dalton Richardson, and D. S. Childs.

The following were elected Honorary Fellows: C. Thurstan Holland, of London, and John Muir, of London, President and Secretary, respectively, of the British Institute of Radiology.

The following new officers were elected: M. J. Hubeny, President-elect; H. M. Imboden, Vice-president-elect.

Dr. Case, as Chairman of the Standardization Committee, made a favorable report on the accomplishment of increased efficiency due to elevation of the minimum standard of personnel and equipment. Dr. Hickey, Dr. Pancoast, and Dr. Case were continued on this committee in recognition of what they had done.

The Faculty of Tufts College, Massachusetts, has conferred the honorary degree of Doctor of Science upon Dr. Arial W. George, a member of this Society.

RECENT COURT DECISIONS INVOLVING ROENTGENOGRAMS

A case heard before the Court of Errors and Appeals of New Jersey (*Greco v. Schmidt, N. J., 128 Atl. R. 146*) to recover for personal injuries sustained by a child when run down by a motor truck, involved roentgenograms taken by another than the physician testifying. However, the films were taken by a physician who customarily performed that service at the hospital at which the testifying physician was engaged

in professional work, and under his direction. As ruled in a case cited, if the identity of roentgenograms is established either by the physician making them, or by the one for whose use they were made, and employed by him in the treatment of the injury, they are admissible as evidence.

In a case before the St. Louis (Mo.) Court of Appeals, an action to recover damages for personal injuries sustained, objection was made that the roentgenograms taken of the injured person were not themselves introduced in evidence, but the physician's interpretation of them. The films were, as a matter of fact, lost, but the court ruled that they were not essential, the interpretation of them by an expert being the best evidence. The trial court's admission of the physician's testimony (*Spellmeyer v. Theo. Hiertz Metal Co., Mo., 272 S. W. R. 1068*) as to his findings in the matter of the plaintiff's injuries, aided by and based upon the roentgenograms, was sustained.

ABSTRACTS OF CURRENT LITERATURE

INDEX TO ABSTRACTS IN THIS ISSUE

ALVAREZ, WALTER C. (*with* MUSGRAVE, W. E., BOARDMAN, W. W., ULLMANN, H. J., and RUGGLES, HOWARD E.) 179, 180
BARTLETT, E. I. (*with* SEARLS, H. H.) 178
BERGER, SAMUEL S., COHEN, MILTON B., SELMAN, J. J. Liver Function Tests: A Comparative Study of Five Methods in One Hundred Clinical Cases 184
BERKLEY, HUGH (*with* MCCLEAVE, T. C., ULLMANN, H. J., MORRIS, MYRL, LAMB, EDWARD J., FARMER, JESSIE C., and CHAMBERLAIN, W. EDWARD) 175, 176
BEZANCON, F., and WEIL, M.-P. Rheumatic Aortitis 183, 184
BOARDMAN, W. W. (*with* MUSGRAVE, W. E., ALVAREZ, WALTER C., ULLMANN, H. J., and RUGGLES, HOWARD E.) 179, 180
BOWING, HARRY H., and VINSON, PORTER P. Surgical Diathermy for Tumors of the Trachea .. 180, 181
BRYAN, LLOYD (*with* WOLFSON, M.) 177, 178
BUCKSTEIN, JACOB. Multiple Sacculations of the Esophagus 175
CHAMBERLAIN, W. EDWARD (*with* MCCLEAVE, T. C., BERKLEY, HUGH, ULLMANN, H. J., MORRIS, MYRL, LAMB, EDWARD J., and FARMER, JESSIE C. 175, 176
COHEN, MILTON B. (*with* BERGER, SAMUEL S., and SELMAN, J. J.) 184
COLE, WALLACE H. Giant-cell Tumor Involving Phalanges 184
COSTOLOW, WILLIAM E. (*with* SOILAND, ALBERT) ... 181
DEBICKI, J. J. X-ray Treatment of Laryngeal Tuberculosis 176
DORNO, C. Contributions to the Knowledge of Sun and Quartz Light Erythema 115
FARMER, JESSIE C. (*with* MCCLEAVE, T. C., BERKLEY, HUGH, ULLMANN, H. J., MORRIS, MYRL, LAMB, EDWARD J., and CHAMBERLAIN, W. EDWARD) 175, 176
FARR, CHARLES E. Unusual Articulation of the Astragalus and the Os Calcis 108
GABRIEL, G. Influence of Roentgen Rays on Animal Organs 175
GAUDIER, H. Median Sternotomy in Mediastinal Tumors 180
GAUILLARD, R. D. (*with* GUILBERT, C.) 181, 182
GLOCKER, R., and KAUPP, E. Accuracy of Potential Measurements with a Spectograph 176
GUILBERT, C., and GAUILLARD, R. D. The Roentgen Treatment of Hypertrophy of the Prostate. 181, 182
HANKS, MARY ELIZABETH. The Roentgen Ray as a Remedy in Fibroids and Other Gynecologic Diseases 174
HENDRICKS, WILLIAM A. (*with* MAYO, CHARLES H.) 118
KAUPP, E. (*with* GLOCKER, R.) 176
KUPFERBERG, H. Regarding the Temporary Sterilization with Radium 183
LAMB, EDWARD J. (*with* MCCLEAVE, T. C., BERKLEY, HUGH, ULLMANN, H. J., MORRIS, MYRL, FARMER, JESSIE C., and CHAMBERLAIN, W. EDWARD) 175, 176
MCCLEAVE, T. C., BERKLEY, HUGH, ULLMANN, H. J., MORRIS, MYRL, LAMB, EDWARD J., FARMER, JESSIE C., and CHAMBERLAIN, W. EDWARD. The Management of Patients with Whooping Cough 175, 176
MAJOR, RALPH H., and WAHL, H. R. Paroxysmal Tachycardia Associated with Focal Myocarditis 184
MAYO, CHARLES H., and HENDRICKS, WILLIAM A. Carcinoma of the Right Segment of the Colon. 118
MORRIS, MYRL (*with* MCCLEAVE, T. C., BERKLEY, HUGH, ULLMANN, H. J., LAMB, EDWARD J., FARMER, JESSIE C., and CHAMBERLAIN, W. EDWARD) 175, 176
MUIR, JOSEPH. Technic of Use of Removable Radon Seeds in Carcinoma of the Tongue 173
MUSGRAVE, W. E., BOARDMAN, W. W., ALVAREZ, WALTER C., ULLMANN, H. J., and RUGGLES, HOWARD E. Bedside Medicine for Bedside Doctors 179, 180
ORTON, HENRY BOYLAN. Anterior Dislocation of the Atlas as a Cause for Inability to Swallow Solid Foods 179
ORTON, HENRY BOYLAN. Traumatic Perforation of the Esophagus 182, 183
OTTOW, B. Vesical Lesions Produced by Sodium Bromide Solutions 183
RICHARDS, G. E. X-rays and Radium in the Management of Breast Carcinoma 174, 175
RIES, EMIIL. The Danger of Malformation of Fetus in Roentgen-ray Treatment during Pregnancy. 182
RUGGLES, HOWARD E. (*with* MUSGRAVE, W. E., BOARDMAN, W. W., ALVAREZ, WALTER C., and ULLMANN, H. J.) 179, 180

SCHACHNER, AUGUST. Questions Involved in Operative Procedures in Cases of Gastric and Duodenal Ulcers 118
SCHNEIDER, E. The Biological Effect of Roentgen Rays on Single Cell Organisms, Based on Experiments with Paramecium..... 115
SCHOENHOF, C. (*with* WAGNER, G. A.)..... 182
SCHOENHOF, S. Experiments Regarding the Indirect Radiation of Skin Diseases..... 180
SCHULTZE, W. On Reflection and Absorption of the Skin in the Visible Spectrum..... 108
SEARLS, H. H., and BARTLETT, E. I. Thyroiditis... 178
SELMAN, J. J. (*with* BERGER, SAMUEL S., and COHEN, MILTON B.) 184
SHUMAN, JOHN W. Cancer of Stomach..... 183
SISSON, RAYMOND J. Cutis Verticis Gyrata..... 174
SOILAND, ALBERT, and COSTOLOW, WILLIAM E. Radiation Treatment of Superficial Malignancies. 181
STAYTON, CHESTER A. The Radiographic Examination as a Factor in the Diagnosis of Chronic Respiratory Infections 177
TODTENHAUPT, W. A Peculiar Cause for the Development of an X-ray Ulcer.....178, 179
ULLMANN, H. J. (*with* MCCLEAVE, T. C., BERKLEY, HUGH, MORRIS, MYRL, LAMB, EDWARD J., FARMER, JESSIE C., and CHAMBERLAIN, W. EDWARD.) 175, 176
ULLMANN, H. J. (*with* MUSGRAVE, W. E., BOARDMAN, W. W., ALVAREZ, WALTER C., and RUGGLES, HOWARD E.).....179, 180
VINSON, PORTER P. (*with* BOWING, HARRY H.)..180, 181
WAGNER, G. A., and SCHOENHOF, C. Experiments and Histological Examination to Study the Mechanism of the Effect of Small Roentgen-ray Doses on the Human Female Generative Glands 182
WAHL, H. R. (*with* MAJOR, RALPH H.)..... 184
WEIL, M.-P. (*with* BEZANCON, F.).....183, 184
WIEL, HARRY I. Clinical Picture of Beginning Carcinoma of the Stomach.....176, 177
WOLFSON, M., and BRYAN, LLOYD. Infectious Muscular Erosion: An End-result in the Lumbar Region 177, 178
WUCHERPFENNIG, V. Influence of Line Fluctuation on the Doses in Roentgen-ray Therapy.....173, 174

Removable radon seeds in carcinoma of the tongue.—This article describes a new technic of radium therapy in lingual carcinoma which offers a practical means of irradiating even the most inaccessible tongue lesions. This is accomplished by the implantation of removable platinum radon seeds. As the methods of treatment heretofore used have always proved unsatisfactory, this article is of especial importance from a clinical standpoint.

The various methods by which lingual carcinoma has previously been treated are discussed and their advantages and drawbacks considered. Imbedding of bare tubes according to Janeway's method affords an even distribution of radiation, but causes necrosis which is invariably followed by sloughing and may even induce unavoidable fatal hemorrhage. If screened seeds are used, necrosis is avoided, but they are objectionable because they must remain in the tongue as foreign bodies. The platinum needles advocated by Régaud also obviate necrosis and can be removed when radiation has been accomplished, but proper distribution of these applicators is very difficult; they cause too much trauma; and, above all, they are hard to immobilize and cannot be placed upon the posterior dorsal surface of the tongue.

The method offered in this article obviates these difficulties, while retaining the desirable features. The seeds are completely screened with platinum, thus doing away with necrosis and sloughing; they are easily withdrawn after adequate dosage has been delivered, so that they do not remain in the tissue as foreign bodies. These seeds can be placed in any position required, just as readily in the hitherto inaccessible "root" of the tongue, as in more favorable positions. The article is profusely illustrated, demonstrating the exact method of approach to these inaccessible lesions.

The growth is first carefully palpated, and the number of seeds required determined according to its depth and surface extent. When a seed has been placed in the desired position, the attached thread is left protruding from the point of entry, where it is cut off so as to leave just enough to be readily grasped with forceps at the time of removal.

The entire treatment causes no pain, and but slight inconvenience to the patient; and when skillfully performed under proper aseptic precautions, the technic offers an excellent means of solving one of the most vexing of clinical problems.

Technic of Use of Removable Radon Seeds in Carcinoma of the Tongue. Joseph Muir. Annals of Surg., May, 1926, p. 598.

Line fluctuation and dosage in superficial therapy.—The author investigated the influence of line fluctuation on the dosage in superficial therapy. A Friedrich iontoquantimeter and a Seemann spectograph were used for radiation measurements, while a voltmeter and rheostat in the primary circuit allowed control of the potential at the ends of the primary windings of the transformer. It appears that a roentgen-ray dose does not decrease proportionally to the drop of the line voltage. Unfiltered radiation is reduced in the ratio 1:2, through 2.0 aluminum in the ratio of 1:3—in other words, the drop in the line causes twice or three times the drop in the X-ray output The probable explanation is the shifting of the short wave length end of the spectrum towards the longer wave end, according to the Planck-Einstein equation, and also a reduction in the total intensity of the spectrum. As a remedy, the installation of a rheostat and voltmeter in the primary circuit is

recommended; this allows one to keep the primary potential of the transformer constant.

E. A. POHLE, M.D.

Influence of Line Fluctuation on the Doses in Roentgen-ray Therapy. V. Wucherpfennig. Strahlentherapie, 1926, XXII, 172.

Cutis verticis gyrata.—This paper is a case report of a patient suffering from this rare skin condition, one which is characterized by hypertrophy and looseness of the skin, with a tendency to hang in folds. In the present instance there was an accompanying glandular derangement, not mentioned in the literature on the subject. The first clinical study of this condition was made by Jadassohn, and it was later described and named by Unna. These references are cited by the present author. All the reported cases have been males, and of dark complexion, with a single exception.

In the case reported the skin affection was associated with acromegaly, suggesting a possible endocrine basis. The roentgen examination revealed a pituitary fossa of normal size and shape. There was characteristic clubbing of the terminal phalanges. Also, the outline of the lower end of the radius and ulna was somewhat irregular, suggesting periosteal proliferation. The tibia and fibula were considerably increased in width, and an increased density—with irregularity of bone outline—again suggested periosteal proliferation. The patient sought medical aid because of thickness of the upper eyelids, from one of which, under local anesthesia, an elliptic strip, including conjunctiva and tarsus, was excised for examination. Following this procedure, six roentgen treatments, one every two weeks, were given. There ensued definite relief from the over-secretion of oil in the skin of the forehead and scalp, but no apparent change in the thickness of the lids. Further treatment was not advised, and when last seen the patient's condition was unchanged. Pathologic examination of the excised tissue showed chronic conjunctivitis, with marked proliferation of palpebral conjunctiva, with formation of glands, many of which were distended with concretions.

Cutis Verticis Gyrata. Raymond J. Sisson. Jour. Am. Med. Assn., April 10, 1926, p. 1126.

X-ray in gynecology.—Nine years of work, totaling 374 cases, has convinced the writer that X-ray is the remedy of choice in selected, nonmalignant cases of the female pelvic organs, and that low voltage rays are to be preferred.

Technic: Spark gap 9 inches; distance 12 to 17 inches; 5 milliamperes of current; filter, 3 to 5 mm. of aluminum and sole leather; exposure time 14 to 17 minutes, through as many portals of entry (3 to 5 inches in diameter) as may be required to cover pathology under treatment.

Each case requires careful diagnosis, selection, and attention to individual needs.

Practically all cases of fibromyoma fall into three groups: first, those unsuitable for X-ray; second, those which may be accepted with a guarded prognosis; third, hemorrhagic intramural fibroids which are the type most suitable for treatment.

Contra-indications: 1. Tumor associated with acute symptoms, chills and fever; also cystic types. These are surgical cases. 2. A tumor associated with large ovarian tumors (surgical). 3. Most pedunculated tumors should be operated on. 4. Cases having acute gonorrheal infection. 5. Malignancy (this requires surgery or high voltage X-ray or radium, or all combined). 6. Submucous tumors. 7. Large non-vascular tumors. 8. Tumors which may be removed surgically in cases of women desiring to bear children.

Hemorrhage at the menopause is a most satisfactory condition to treat. The gradual application of moderate doses of X-ray is almost specific.

Simple follicular ovarian cysts originating in ovarian follicles are promptly modified or cured by X-ray.

Cervicitis, with degenerating cervical glands and erosions, is successfully treated with X-ray.

Chronic adhesions and indurations are favorably influenced by X-ray.

No completed case in the author's series has developed malignancy so far as known.

Conclusions: "My experience in the treatment room, corroborated by many roentgen therapists, brings me to the belief that X-ray in the hands of a physician with diagnostic and clinical experience should hold an important place in the armamentarium of the gynecologist."

C. H. DEWITT, M.D.

The Roentgen Ray as a Remedy in Fibroids and Other Gynecologic Diseases. Mary Elizabeth Hanks. Ill. Med. Jour., May, 1926, p. 414.

Breast carcinoma.—In this communication the author summarizes the *modus operandi* of X-rays and radium, discusses the proper dosage, analyzes the three-year results in 108 cases treated, compares the results with those obtained when surgery only is employed, and makes out a strong case for the routine use of these agencies as adjuncts and supplements to surgery.

The old theory of the action of X-rays and radium is no longer tenable. The action of these agencies is not simply a lethal action on the cancer cell, which is more susceptible than the normal body cell. Some, if not most, of the effect is due to an indirect effect induced in the normal body cells. This is somewhat analogous to an immunity effect which renders the normal tissue almost impossible soil for the cancer to grow upon.

Quoting from statistics, the average of the results of ten surgeons—at the end of a three-year period—was 35 per cent of the patients alive and well.

In the author's series of 37 cases of the same type, where surgery was supplemented by prophylactic radiation, over 59 per cent of the patients were found free from disease after three years. This added protection to a group of cases, equal to approximately 25 per cent, is a strong argument for the routine employment of radiation.

As to the matter of technic, the recent widespread employment among radiologists of massive doses of highly penetrating rays, as taught by certain Continental schools, has been attended by two serious clinical complications: the production of fibrosis in the lung, and a lowering of the resistance of the local tissues to the cancer growth. To obviate these complications the author lays down the rule that when X-ray is used for prophylactic purposes in treatment, the dose administered should not exceed a minimum erythema.

In the treatment of post-operative recurrences, a field in which surgery offers nothing, five out of thirty-eight cases were alive and apparently free from disease five years after receiving X-ray and radium treatment.

The dosage of X-rays used for prophylactic purposes is 140 K.V., falling upon the lung, and 210 K.V. over the axilla and supraclavicular areas.

In post-operative recurrences, both X-rays and radium are employed. Radium is used chiefly in treating accessible nodules in which it is desired to secure an intense effect. The platinum needle method of Régaud has been found very effective.

The importance of early operation in cancer of the breast is strongly emphasized. The author has never accepted for treatment by X-rays or radium any such case unless operation was considered impossible by a reputable surgeon or had been definitely refused by the patient.

L. J. CARTER, M.D.

X-rays and Radium in the Management of Breast Carcinoma. G. E. Richards. Can. Med. Assn. Jour., April, 1926, p. 358.

Roentgen-ray effect on animal organs.—The author presents in this paper the results of his investigations as to the effect of roentgen rays on animal organs, with special consideration of the blood capillaries. Irradiation of the surviving rabbit kidney seems to show that the effect is dependent upon the quality and quantity of the radiation; small doses of short wave length dilate, large doses of long waves contract, the blood vessels. After exposure of the inner organs in living animals, the skin capillaries as well as those of the liver, spinal cord, and suprarenals very soon show tonus changes. It is possible by varying the dose administered to the kidneys to produce all stages of an injury, ranging from functional disturbance of the blood vessels to the histological and clinical picture of a chronic nephritis. Histological changes observed in the suprarenals after roentgen radiation explain the cachexia preceding the death of these animals.

(It may be mentioned that no agreement has been reached so far as to the effect of roentgen radiation of suprarenals in man. Some believe that 30 to 40 per cent S.U.D. is extremely dangerous, while others are not convinced of the very high sensitivity of these organs towards roentgen rays.)

E. A. POHLE, M.D.

Influence of Roentgen Rays on Animal Organs. G. Gabriel. Strahlentherapie, 1926, XXII, 107.

Roentgen examination of esophagus. — In the case reported in this brief paper clinical examination had resulted in no diagnosis. In the course of routine roentgen-ray examination of the gastro-intestinal tract, sacculations of the esophagus were discovered.

Multiple Sacculations of the Esophagus. Jacob Buckstein. Jour. Am. Med. Assn., April 10, 1926, p. 1128.

Whooping cough.—This subject is discussed by several physicians, under the heading "Bedside Medicine for Bedside Doctors." McCleave, in discussing the various remedies used, says of the X-ray: "X-ray treatment of whooping cough is now widely used, with favorable effect, and is recommended in all cases where the paroxysms are severe and do not yield readily to other treatment, or where the cough is unduly prolonged due to the persistence of enlarged lymph nodes."

Ullmann says his experience has been limited, but, from the parents' statements, his impression is that the severity and frequency of the paroxysms are lessened. The effect of the X-ray

treatment is most noticeable where the cough has persisted for weeks and there is no further response to drugs or vaccines. He believes that for the present, at least, it should be reserved for the older subacute and chronic cases that have failed to respond to other methods of treatment. Furthermore, he emphasizes the fact that treatment should be given only by a physician trained in the work.

Morris withholds definite conclusions regarding the use of X-ray for the present, especially since reading the article by Faber (*Jour. Am. Med. Assn.*, Sept. 12, 1925) in which it is stated that untreated controls follow the same clinical course for a period of eight weeks as do the irradiated cases.

Lamb recommends X-ray for infants under one year and also for children of marked instability. Though limited in number, his cases treated by X-ray have shown marked improvement.

Farmer says the belated adoption by the laity of remedial measures abandoned by the medical profession makes it difficult for the physician to enforce his plan of treatment of whooping cough in the home of the afflicted. Cresoline and other repulsive vapors smother the house. The vaccine wave has surged over the parents, leaving them with an exaggerated faith in the prophylactic and curative effects of dead cultures. Later, there will be a clamor by the laity for the magic of the X-ray. The people are following more closely than formerly our tortuous trail of changing methods, with this exception: we *hoped* our measures would prove specific and they believe that they are specific.

Chamberlain says that in the past two years there have been many treatments given for whooping cough and many articles written. These latter for the most part show the technic of the author and report such of the cases treated as show improvement. He mentions Struble's work (*Jour. Am. Med. Assn.*, Sept. 12, 1925) in which untreated control cases and irradiated cases follow the same course. Interestingly enough, the mothers of the treated children held the improvement to be due to the X-ray treatment, but parallel and equal improvement was seen in the controls. In the management of whooping cough, then, Chamberlain would leave out X-ray therapy, not through the feeling that the treatment in competent hands is dangerous, but on the ground that it is futile.

F. B. Sheldon, M.D.

The Management of Patients with Whooping Cough. T. C. McCleave, Hugh Berkley, H. J. Ullmann, Myrl Morris, Edward J. Lamb, Jessie C. Farmer, W. Edward Chamberlain. Calif. and West. Med., April, 1926, p. 502.

Laryngeal tuberculosis. — The author reports most encouraging results following the X-ray treatment of laryngeal tuberculosis. He quotes a number of authors who have obtained similar results, particularly during the last five years; they all emphasize the anesthetic effect of the treatment. Since 1921 Debicki has treated 33 patients with laryngeal tuberculosis, of whom 26 were completely cured. He employs a spark of 0.27 cm. and the filter is made of 4 mm. aluminium and 5 mm. cardboard or wood; the anti-cathode is placed at a distance of 0.23 cm. from the skin. The larynx is irradiated every week, alternately on either side. The treatment is repeated after an interval of four to six weeks, according to the progress of the disease.

The author does not agree with those who consider that destructive lesions contra-indicate X-ray treatment. Three of his patients were 52 to 62 years of age. Two patients were completely cured after treatment lasting for more than a year; in the other case a recurrence occurred after six months. The author states that while the most favorable results are obtained in early cases, serious destructive forms may be equally treated with success. The optimum dose is 5 Holzknecht units applied every week to each side alternately, and repeated after an interval of four to six weeks between each course. Apparent aggravations occurring during the course of treatment are not held to contra-indicate its continuance. The treatment should be continued for some time after the disappearance of all symptoms.

X-ray Treatment of Laryngeal Tuberculosis. J. J. Debicki. Jour. de Radiol. et d'Electrol., March, 1926, p. 120. (Reprinted by permission from Brit. Med. Jour., June 5, 1926, p. 95 of Epitome of Current Medical Literature.)

Spectographic potential measurements.— This paper gives many valuable data for the potential measurement in X-ray work with the Seemann spectograph. A very similar device (micrometer with slide) which can be attached to any microscope is described; this allows a definition of the kilo voltage with 1 to 2 per cent error at 100 K.V., regardless of the degree of blackening of the films.

E. A. Pohle, M.D.

Accuracy of Potential Measurements with a Spectograph. R. Glocker and E. Kaupp. Strahlentherapie, 1926, XXII, 160.

Carcinoma of the stomach.—Wiel reports one case of very early carcinoma of the stomach, proven by surgical operation and histologi-

cal findings, which, because of the uniqueness, he believes worth while the reporting. The patient's illness began about one year before he reported to the doctor, the symptoms being those of indigestion following the eating of fruit. Gastro-intestinal X-ray studies showed a large lesion of the antrum, just inside the pylorus, involving the entire distal third of the stomach. Patient was atropinized for three days to rule out spasm, and the findings were the same. Two days later a laparotomy was done and no tumor mass found. There was a small nodule, 9 mm., just inside the pylorus, which was resected with the pylorus. One small gland was found, excised, and found to be only inflammatory. The tumor nodule was reported typical adenocarcinoma, as yet involving only the mucosa.

From this case Wiel wishes to find something that will help in the early diagnosis of carcinoma of the stomach. There is nothing in the clinical findings. He says that, more disappointing than this, however, is the manner in which the X-ray failed him. Too often we are prone to regard the X-ray findings as matters beyond dispute. He says: "I maintain that we are entirely too smug in our acceptance of radiological dicta, and I think I am safe in speaking for the radiologists themselves in this matter. There are still unexplored fields in interpretations of X-ray photographs."

F. B. SHELDON, M.D.

Clinical Picture of Beginning Carcinoma of the Stomach. Harry I. Wiel. Calif. and West. Med., May, 1926, p. 628.

Diagnosis of chronic respiratory infections.—This is a study of the indirect visualization of the thoracic viscera made possible by the development of the method of stereoscopic examination. The technical requirements are as follows:

1. Both films taken while patient holds the breath.
2. Patient in upright position if possible.
3. Rapid exposure: 1/20 to 1/4 second.
4. Precision mechanism for film and tube shifts.
5. Tube at least 30 inches from the patient.

Each patient should have a thorough fluoroscopic examination at the time of film examination. Findings should be studied and correlated with film findings.

Pathologic conditions in which X-ray examination is most helpful are as follows:

1. Lung abscess and lung gangrene.
2. Bronchiectasis and emphysema.
3. Thoracic neoplasms, primary and metastatic.
4. Pleural effusions and empyema.
5. Lung pathology due to foreign bodies.
6. Chronic pleurisy.
7. Pulmonary tuberculosis.
8. Lobar pneumonia and bronchopneumonia.
9. Cardiac lesions.

The writer's conclusions are as follows:

1. Postmortem examination has shown that lung pathology, as shown in X-ray films, varies in quality and degree of density from the dark to the light shadows as here enumerated: (*a*) serous exudate; (*b*) cellular exudate; (*c*) fibrosis; (*d*) caseation, and (*e*) calcification. Thus is provided a method of studying pathological tissue changes in the living patient in much the same manner as the pathologist makes gross studies at autopsy.

2. The roentgenologist is a consultant and should have knowledge of the history, symptomatology and physical findings. He should render an X-ray diagnosis rather than a clinical diagnosis.

3. The X-ray is of value in the upper respiratory tract as a diagnostic adjunct in determining the presence of focal infection in nasal accessory sinuses, teeth and mastoids.

4. X-ray gives most accurate information regarding type and amount of pathology in the chronic lung infiltrations.

5. A roentgen diagnosis of pulmonary tuberculosis is never warranted on enlarged trunk and linear markings and hilum infiltration. There must be definite parenchymal changes.

6. Co-operation between the clinician, pathologist and roentgenologist will lead the way to greater knowledge of chronic respiratory diseases.

C. H. DEWITT, M.D.

The Radiographic Examination as a Factor in the Diagnosis of Chronic Respiratory Infections. Chester A. Stayton. Jour. Ind. St. Med. Assn., May 15, 1926, p. 193.

Infectious muscular erosion.—The authors record a case of infectious muscular erosion causing hernia of the large bowel in the lumbar region, and remark that the case is instructive, showing to what an undiagnosed appendiceal abscess may lead. A married woman, aged 38, was admitted to hospital complaining of pain in the right lower abdomen accompanied by a low-grade septic temperature. There was a history of Cesarean section seven years previously, and successful hemorrhoidectomy, trachelorrhaphy, and anterior and posterior colpoplasty a month before admission. The X-ray examination and blood and urine analyses were negative, and the patient was discharged on a diagnosis of hysteria, with post-operative adhesions. On two subsequent occasions she was readmitted,

with practically the same symptoms, together with a pain over the lower right lumbar region and an extremely hypersensitive area over the right iliac crest. Nine months later a tender swollen mass was detected in the right lumbar region, extending from the right midaxillary line to the spine, and a deep-seated abscess in the lumbar muscles and under the iliac crest was opened, the discharge from which contained Gram-negative intercellular diplococci. Two months later an X-ray examination of the spine and pelvis was negative.

The abscess recurred three times during the following nine months, and for the next three years the patient was in poor health, and stated that the mass over the right hip frequently became prominent and subsided without treatment. On palpation, slight pressure would cause it to disappear, only to return immediately on release, and especially on coughing or straining.

On X-ray examination with an opaque meal the ascending colon and cecum were found to extend through the lumbar muscles posteriorly into a large hernial sac, which was found at operation to be covered by a flap of fascia which had been eroded through by the old abscess. The sac was dissected down to the hernial opening over the right iliac crest, where the remains of an old perforated retrocecal appendix were found, at the tip of which was a walled-off abscess the size of a walnut. The hernial opening was closed and the patient made an uneventful recovery.

Infectious Muscular Erosion: An End-result in the Lumbar Region. M. Wolfson and Lloyd Bryan. Boston Med. and Surg. Jour., April 1, 1926, p. 586. (Reprinted by permission from Brit. Med. Jour., June 5, 1926, p. 93 of Epitome of Current Medical Literature.)

Acute thyroiditis.—This condition is quite rare in this country, and, when found, is commonly a sequel to tonsillitis, otitis media, scarlet fever, pneumonia, or typhoid. Exophthalmic goiter may follow an acute thyroiditis, or, with destruction of the gland, evidence of insufficiency may develop. Under the heading of "chronic thyroiditis," mention is made of tuberculous thyroiditis, which is a common incident of miliary tuberculosis, and of syphilitic thyroiditis, always a rare disease and under modern antiluetic treatment becoming even less frequent. The authors deal mostly with the chronic, diffuse type of the disease, which condition is very difficult to diagnose. Of seventeen such cases selected from the files of the University of California Hospital, only three were correctly diagnosed pre-operatively, eight were called toxic adenoma, and the other six hyperplasia. Because of this error in diagnosis a careful study of the records was made to try to determine the clinical points for the pre-operative diagnosis of this condition. A series of cases of hyperplasia with associated chronic thyroiditis were also studied.

The following points may suggest chronic inflammation of the thyroid, either as a clinical entity or as secondary to hyperplasia: (1) History of recent infection in the mouth; (2) Symptoms and signs of decreased function, together with hyperthyroidism, suggesting thyroiditis with or without hyperplasia; (3) A slight swing in the temperature curve is suggestive; (4) On palpation, indurated areas may give a nodular impression, strongly suggesting adenomata; (5) Practically always, adhesions of the surrounding muscles to the capsule of the thyroid are noted. (Chronic inflammation is, perhaps, more logically a cause of such adhesions than roentgen therapy.); (6) A tender lymph node over the isthmus, in one case of frank hyperplasia, led to the additional diagnosis of thyroiditis.

In differentiating between chronic thyroiditis alone and hyperplasia with inflammation, the following points may be of value: (1) Exophthalmos, bruit and thrill are pathognomonic of hyperplastic goiter; (2) Tenderness over the gland is common in thyroiditis; (3) Basal metabolic rate is rarely elevated in chronic thyroiditis without associated hyperplasia, and may be below normal even; (4) The gross picture at operation of a vascular, friable, adherent gland, which, on section, shows a mottled surface and increased fibrosis, will suggest thyroiditis.

A subtotal bilateral lobectomy has been performed on all these patients. From the seventeen operated on from four years to six months previously, nine answers were received to follow-up letters. One patient had received no benefit from surgical treatment; became weaker, developed psychosis, and died. Another had died a few months after operation, apparently from other causes. Two were moderately improved, two were markedly improved, and three were completely cured by their surgical treatment.

F. B. Sheldon, M.D.

Thyroiditis. H. H. Searls and E. I. Bartlett. Calif. and West. Med., May, 1926, p. 639.

Peculiar cause of X-ray ulcer.—A woman, 48 years of age, had a gastro-intestinal examination on June 15, 1921, and was fluoroscoped eight times after that, the last examination being done on June 20, 1921. In July, 1921, she

had a mosquito bite in the skin over the upper sacrum; pustula appeared soon, and an ulcer formed which healed in four weeks. In March, 1922, and again in May, 1925, examination disclosed a scar over the sacrum about six centimeters in diameter, with telangiectasis and slight desquamation. The author considers the mosquito bite as the cause for the development of this lesion which was diagnosed as an X-ray ulcer.

E. A. POHLE, M.D.

A Peculiar Cause for the Development of an X-ray Ulcer. W. Todtenhaupt. Strahlentherapie, 1926, XXII, 191.

Anterior dislocation of the atlas. — The author reports the following case: Patient was a child four years of age who was brought in December 2, 1924, with the complaint of inability to swallow solid foods for the past three years. Dr. Baker, roentgenologist, reported as follows: X-rays taken with the idea of a foreign body being located or a persistent hypertrophy of the thymus gland. Examination of the esophagus was conducted in the usual manner. Before the fluoroscope the barium was observed to pass quickly into the stomach, no evidence of obstruction being visible. The patient was then given a thick mixture of barium, and films taken. No evidence of obstruction was observed. On close scrutiny of the X-ray film, an anterior dislocation of the atlas was seen. A lantern slide was forwarded to Dr. Jackson for his opinion, and both he and Dr. Manges agreed as to the dislocation. The question is the treatment of the condition.

B. C. CUSHWAY, M.D.

Anterior Dislocation of the Atlas as a Cause for Inability to Swallow Solid Foods. Henry Boylan Orton. Laryngoscope, March, 1926, p. 188.

The practicability of radiologic visibility of the gall bladder: Its availability, indications and values to the family doctor.— This subject is discussed under the heading "Bedside Medicine for Bedside Doctors," and the Editor's comments upon it, noting that improved radiologic technic in the diagnosis of gall-bladder trouble gives evidence of value, seem amply demonstrated. The value to the patient of this positive evidence where formerly conclusions were arrived at by indirection, is obvious. But this is not enough; he believes that the technic must be more simplified and the costs reduced before it can be available to or paid for by the average patient. That the vast majority of physicians have taken little interest so far in this live subject, is indicated by the fact that, of the many invited to discuss the subject, all except those well known for their radiologic experience declined to take part in the discussion.

Boardman discusses the subject under three headings: (1) after clearing the intestinal tract; (2) after administering the dye; (3) supplemental barium meal study of the entire intestinal tract. He believes that the oral method may be used routinely for ambulatory patients, but where there is incomplete visualization of the gall bladder little importance can be put on the test unless repeated by the intravenous method. From this review it is evident that we have at our disposal means of studying the size, shape, position and outline of the gall bladder, its filling, its concentrating function and its emptying, as well as any variation in the density of the shadow. Also, in the occasional case, we can demonstrate gallstones, and the presence of adhesions or pressure from the gall bladder on the duodenum, antrum and hepatic flexure of the colon. The most careful technic is necessary in obtaining this evidence, and skill, experience and conservatism are absolutely essential to a proper interpretation of the findings.

Alvarez has been using the Graham technic in his office for some time, but has not yet made up his mind as to its value. He mentions a talk with Carman, who, after using it on several thousand patients, had come to the conclusion that it was of distinct value in the diagnosis of gall-bladder disease. He had found that there was no need to give keratin- or salol-coated capsules. The important point made by Carman was that the bromin salt was by far the best to give by mouth, and the iodin to give intravenously. At the Mayo Clinic they always give bromin salt first by mouth: the salt at 8 in the evening and film the patient at 10 next morning. If the gall bladder shows up well, nothing more need be done; if not, the iodin salt is given intravenously. They take only the one set of films, not repeating at eighteen or twenty hours.

Ullmann, after a year's experience, has come to the conclusion that it is of distinct value. He uses capsules hardened in formalin vapor. The dye is made into a thin paste with neutral or alkaline olive oil. The first film is a 14×17, to determine whether or not the dye has been absorbed. If there is little or no absorption of the dye, the examination is repeated in a day or two, first giving a good dose of compound licorice powder twenty-four hours before the dye. He has had gallstones become visible after this procedure, when no results were obtained the first time. Ullmann emphasizes the absolute necessity of using the intravenous method in cases

where the examination was negative when the dye was given orally.

Ruggles finds that it has been of greatest value in demonstrating gallstones. With good technic, practically all gallstones can be visualized. This alone is sufficient to establish the method on a permanent basis. The iodide salt is preferable and should be administered in 7½ gr. capsules. Films are made at 15, 18, and 20 hours after taking the capsules, no food being allowed until after making the 18-hour film; then a fat meal is ordered. If the gall bladder is not seen the examination should be repeated, and if the second attempt is likewise negative, gall-bladder disease, a blocked cystic duct, or gross liver pathology should be suspected. Intravenous injection is troublesome and unnecessary in most cases.

F. B. SHELDON, M.D.

Bedside Medicine for Bedside Doctors. W. E. Musgrave, Editor; W. W. Boardman, Walter C. Alvarez, H. J. Ullmann, Howard E. Ruggles. Calif. and West. Med., May, 1926, p. 654.

Indirect radiation of skin diseases. — A number of skin diseases seem to be correlated with disturbances of the inner secretion. This assumption has led, *e.g.*, to the treatment of the thymus with small X-ray doses in psoriasis (Brock). This paper deals with roentgen therapy based on the same principle. Several cases are reported of women suffering from various dermatoses, in which one-twentieth S.U.D. over each ovary benefited the skin condition greatly. One case of alopecia areata was improved by small doses given to the hypophysis. In lupus erythematosis, in which condition the regional lymph glands are often enlarged, their exposure clears up the skin eruption.

E. A. POHLE, M.D.

Experiments Regarding the Indirect Radiation of Skin Diseases. S. Schoenhof. Strahlentherapie, 1926, XXII, 148.

Treatment of mediastinal tumor. — The author has recently had occasion to try the effect of median sternotomy to relieve the pressure effects in a case of a malignant tumor arising in the mediastinum. The patient had been operated on eleven years previously for carcinoma of the breast; this was followed by a recurrence in the mediastinal glands. There was much swelling of the arm on the affected side, which presented the appearance of elephantiasis; trophic ulcers developed on the fingers, and there was also severe pain.

Radiographic examination showed the presence of a large mass, probably arising in the glands in the mediastinum. Treatment by deep therapy appeared to aggravate the symptoms by giving rise to pressure effects. As the conditions were becoming intolerable, it was decided to attempt a decompression operation on the mediastinum. Laryngoscopy and esophagoscopy brought to light no paralysis or obstruction, although the patient could swallow only with difficulty. The sternum was divided in the midline under local anesthesia, and without difficulty. A separation of 3 cm. was obtained and the symptoms were immediately relieved. The wound was closed with drainage.

The condition of the patient was much improved, and she could swallow and sleep with much comfort. Deep X-ray therapy was started again, and caused no trouble. The operation appears one which has definite indications in such cases, and there is little risk in its performance.

Median Sternotomy in Mediastinal Tumors. H. Gaudier. Bull. et Mem. Soc. Nat. de Chir., March 6, 1926, p. 245. (Reprinted by permission from Brit. Med. Jour., May 29, 1926, p. 89 of Epitome of Current Medical Literature.)

Tumors of the trachea. — These neoplasms are usually malignant, and the treatment is, of course, only palliative. Surgical diathermy, the authors believe to be an effective factor in such palliative treatment, as it reduces the size of the growth and permits free respiration, at least temporarily. For the effective application of this electrical treatment, the lesion must be localized and accessible. The scars resulting are soft and uncomplicating and the contractures always slight.

The equipment consists of a portable cabinet with a three-stage tungsten-point spark gap and a five-point rheostat control; transformer of the dry type, depending on air and space for insulation. Condensers are triple and of solid mica plate construction. The alternating current used was 110 volts, 60 cycle.

The authors report a case as follows: Male, age 41, always been well save for frequent "colds," until December, 1919, when he began to expectorate blood frequently, and had slight elevation of temperature. Pulmonary tuberculosis was diagnosed and patient sent to New Mexico for treatment. Three months later he had severe attack of pneumonia and was ill for three months. Following this he complained of dyspnea on slight exertion, frequent asthmatic seizures, and cough.

On general examination in June, 1924, the patient seemed to be in excellent condition, but chest examination revealed evidence of an obstructive lesion of the right main bronchus. Roentgenologic examination of the chest re-

vealed an apparent thickening of the pleura on the left side. June 27, a bronchoscopic examination, under local anesthesia, revealed a tumor arising from the right and posterior wall of the trachea just above the bifurcation. The mass was so large that the bronchial opening could not be identified. Growth appeared malignant, but piece of tissue removed was reported as only inflammatory fibrous tissue.

The point of the active electrode was inserted into the center of the presenting wall of the tumor, current turned on and off by the assistant. Coagulating time varied from twenty to thirty seconds. About 30 to 40 per cent of tumor coagulated at first operation. Nine days later another bronchoscopic examination revealed the tumor to be decreased about 50 per cent. Its apex was quite necrotic. Markedly less obstruction to breathing. Patient coughed up small pieces of degenerated tissue five or six days after destruction of the mass.

December 24, he again appeared for examination. Bronchoscopic examination showed mass to be one-fourth original size. The remaining tissue was coagulated and a course of radium treatments was also carried out. Reaction from the radium treatment was negligible; only slight nausea and weakness for short period. About three months later patient presented no symptoms referable to the lesion. He promised to return for further observation and possible treatment in six months.

In conclusion, the authors state that they believe that surgical diathermy has a place in the treatment of neoplasms in areas revealed by the bronchoscope. Perfect high frequency currents should be employed, as they generate regularly and are well balanced.

B. C. CUSHWAY, M.D.

Surgical Diathermy for Tumors of the Trachea. Harry H. Bowing and Porter P. Vinson. Laryngoscope, March, 1926, p. 217.

Superficial malignancies. — The extensive literature of the last ten years, describing successful treatment of superficial malignancies, has caused this method to be almost universally adopted. However, occasionally, some one attempts to discredit the radiation treatment. Small superficial malignancies may be destroyed by any of several methods, but the authors believe that radiation is the method that is easiest for the patient, most accurate, and thorough from a scientific standpoint. Either X-ray or radium may be used successfully, but they believe that radium gives the best results. In the small areas of keratosis that is breaking down, and the small localized basal-cell epithelioma, the X-ray in lightly filtered dosage is specific.

The authors do not believe that the single massive dose of radium has a place in the entire field of radiation. The divided dose method seems to completely devitalize the malignant cells without so completely devitalizing the normal cells. They mention the unfiltered radium implants and bare needles in the treatment of superficial malignancies, only to condemn them. The caustic action is too severe and often a slough is produced in which actively growing malignant cells are found. Malignant lesions that have been unsuccessfully treated by lightly filtered X-ray or radium, are usually not amenable to further radiation, though a number have responded to heavily filtered radium treatment. Preliminary use of the cautery or of electrocoagulation they believe to be seldom necessary.

In their clinic, from 1920 through 1923, they have treated 897 cases, and they believe that practically the only failures met with are in patients who have been previously improperly treated with X-ray, radium, or other method, and the tissues thus devitalized.

There were 181 cases of epithelioma of the lip, and in all, so far, the authors know the original lesion to have been eradicated. Only four of these patients have died from glandular metastasis. Approximately 15 per cent had had other treatment, and were treated for recurrent lesions. Soiland and Costolow believe that radium will eradicate the local growth in all cases of epithelioma of the lip.

F. B. SHELDON, M.D.

Radiation Treatment of Superficial Malignancies. Albert Soiland and William E. Costolow. Calif. and West. Med., April, 1926, p. 494.

Enlargement of the prostate.—The authors record their experience of X-ray treatment of 45 cases of enlargement of the prostate during the last four years. The results were as follows: 34 were cured by one treatment and 6 by two treatments. In the case of one patient who refused a second treatment, no good effect was obtained, three were subsequently operated on, and one showed a relapse during treatment. On conclusion of the treatment some patients developed bladder trouble owing to infection or deficiency of the bladder muscles, but these symptoms were independent of X-ray treatment. The authors maintain that irradiation of the prostate is a very mild procedure which does not exert any dangerous influence on the organ or interfere with surgical measures, if these are required subsequently. It is important that irradiation should be instituted as early as possible, as a commencing hypertrophy is less sclerotic and more sensitive to X-rays, and the

vesical troubles are transitory and more curable. In order to avoid relapses the portal and general tension should be lowered in plethoric cases, and in infected cases the infection should be cured by vesical irrigation and vaccines.

The Roentgen Treatment of Hypertrophy of the Prostate. C. Guilbert and R. D. Gaillard. Urol. and Cut. Rev., March, 1926, p. 150. (Reprinted by permission from Brit. Med. Jour., June 5, 1926, p. 95 of Epitome of Current Medical Literature.)

Histology of ovaries after small roentgen-ray doses.—The various patients who were to undergo abdominal operations were treated with one-tenth to one-fourth of the sterilization dose; from one day to several weeks later, the ovaries in all these cases were taken out and examined microscopically. No typical change could be observed which might point to a destructive effect from such small doses. Experiments on mice to investigate this problem further are under way.

E. A. POHLE, M.D.

Experiments and Histological Examination to Study the Mechanism of the Effect of Small Roentgen-ray Doses on the Human Female Generative Glands. G. A. Wagner and C. Schoenhof. Strahlentherapie, 1926, XXII, 125.

Fetal malformation. — Since X-rays have been employed with increasing frequency in the diagnosis of pregnancy and in the treatment of pathologic conditions during pregnancy, the question of possible damage to the fetus caused by irradiation has attained considerable interest. The group of cases under consideration were irradiated before conception or on the uterus during various stages of pregnancy. A detailed report is given of a fetus born dead after X-ray treatment administered during pregnancy.

CONCLUSIONS

While there might be some question whether or not the bony malformations had been caused by the roentgen treatment during gestation, there is not likely to be any doubt about the malformations described in the abdomen. As the fetus was approximately mature and the last radiation treatment was given 159 days before the birth of the fetus, it is evident that such conditions as absence of right adrenal, kidney, and ureter, of uterus and vagina, must be due to defects of formation antedating the treatment applied when the fetus was about 109 to 121 days old.

The writer has found no other report of post-mortem examination of a fetus born malformed after roentgen-ray treatment during gestation. For the determination of the connection between roentgen ray and malformation of the fetus further anatomic investigation appears desirable.

L. R. SANTE, M.D.

The Danger of Malformation of Fetus in Roentgen-ray Treatment during Pregnancy. Emil Ries. Am. Jour. Obst. and Gynec., March, 1926, p. 361.

Foreign body.—This is a report of a case of foreign body—a threaded needle—swallowed by a four-year-old child. Long needle shown (examination made June 10, 1924) in both anteroposterior and lateral views, opposite the fourth and fifth dorsal, probably in the esophagus. Point is downward to the right, between the fifth and sixth ribs; the eye is upward to the left, over the left border of the fourth dorsal. Bifurcation of the trachea and both large bronchi above the needle in anteroposterior view and anterior to the needle in the lateral view. Later in the same day, Dr. Baker, roentgenologist of the Newark City Hospital, reported:

"The needle described in the previous report has not changed its position. From its oblique position, I believe that the needle is either in the right main bronchus or has perforated the esophagus or trachea. It is difficult to locate the foreign body definitely. There are several large buttons in the large intestine on the right side in the region of the cecum and ascending colon, and a small metallic foreign body on the left side in the region of the splenic flexure."

Esophagoscopy was done twenty-four hours after the patient's admittance to the hospital.

Conditions found on first endoscopy: Pus and bloody serum in the esophagus and a needle was seen in the esophagus, approximately between the fourth and fifth dorsal vertebræ. The point had penetrated the right side; counter-pressure was made on the left lateral wall and the needle removed.

Difficulties and solution: A lot of thread, constantly interfering with the vision, was attached to the needle.

Duration of operation: 34 minutes, 5 seconds.

Result: Foreign body removed.

Child was put back to bed. Next day he was very restless, breathing labored and cyanosed, gradually growing worse, until breathing ceased two days after swallowing the needle.

Comments: The value of a careful history taken in all cases of foreign body is obvious. In this case it was not until after the foreign body was removed that a subsequent history from the brother revealed the fact that this child

had swallowed a needle with thread attached to the eye. The brother, seeing the thread hanging out of the mouth, pulled on it. The pulling caused the point to catch in the folds of the esophagus and perforation occurred.

B. C. CUSHWAY, M.D.

Traumatic Perforation of the Esophagus. Henry Boylan Orton. Laryngoscope, March, 1926, p. 183.

Temporary sterilization with radium.—After a discussion of the problem of temporary sterilization, the author reports his own experience in regard to the radium treatment of 1,200 gynecological cases, nine of which went through normal pregnancy later; the children were perfectly normal. A certain tendency to abortion may, however, be observed in such patients. He recommends radium application as the method of choice for temporary sterilization because it is more exact as to dosage than roentgen rays. The disadvantage is the necessity of clinical treatment.

E. A. POHLE, M.D.

Regarding the Temporary Sterilization with Radium. H. Kupferberg. Strahlentherapie, 1926, XXII, 141.

Vesical lesions.—According to this author, a 25 per cent sodium bromide solution has now replaced collargol as a contrast medium in cystoradiography, as it gives better images. Several writers, however, have reported the occurrence of hematuria and of renal and vesical lesions following its employment. The author describes two cases of severe cystitis following intravesical injection of 200 c.cm. of a 25 per cent solution of sodium bromide. The first patient, aged 41, had uterine myomata. Immediately after cystoradiography she had dysuria and scanty urine, which persisted for four days. The vesical mucosa was partially detached and the trigone was deeply congested and of a dull blood-red color. In the second case the bladder was anesthetized with 50 c.cm. of a 2 per cent alypin solution prior to the injection of 250 c.cm. of sodium bromide solution, which was followed by a sensation of burning and pressure. Two days later this patient had symptoms similar to the former. Cystoscopic examination two days later showed much damage to the vesical mucosa, ulceration, and bullous edema.

The author recommends that immediately after the radiography the bladder should be emptied and that it should then be irrigated with boric lotion. Since this procedure has been adopted he has not seen any similar injuries to the bladder wall.

Vesical Lesions Produced by Sodium Bromide Solutions. B. Ottow. Zentralbl. f. Gynak., May 1, 1926, p. 1199. (Reprinted by permission from Brit. Med. Jour., June 5, 1926, p. 95 of Epitome of Current Medical Literature.)

Cancer of stomach.—This is a peculiarly interesting case report in that all the facts are available. In October, 1908, the patient, then a man of 33, was operated upon by William Mayo for a tumor, clinically malignant, of the pyloric end of the stomach. A partial gastrectomy was done, following which the man had some sixteen years of comfort, the condition which caused his death in November, 1925, being of less than two years' duration. At necropsy the upper half of the stomach was seen to have been converted into a firm, nodular mass, tightly adherent to the anterior flange of the diaphragm, from which it could not be separated without tearing. The cause of death was extensive carcinoma of the cardiac end of the stomach. At that, the patient had well outlived the five-year limit of recurrence. A photograph of the stomach accompanies the paper, in which are clearly discernible the traces of the early operation.

Cancer of Stomach. John W. Shuman. Jour. Am. Med. Assn., April 10, 1926, p. 1127.

Rheumatic endocarditis. — These authors review the literature and record a case, a girl, age 21, who developed her first attack of acute rheumatism at the age of 14, when the heart was not affected. The following year she had a second attack, when the existence of rheumatic endocarditis was detected. The third attack, which occurred five years later, was subacute in character, almost entirely apyrexial, and principally involved the aorta. The first part of the vessel was affected not only in the valves but in the trunk as well. The ascending portion was found on X-ray examination to be the seat of a cylindrical dilatation which was revealed clinically by a thrill and a pulsation which was most prominent in the right presternal region. There was a loud systolic murmur at the base of the heart, conducted towards the outer half of the right clavicle, and a less intense diastolic murmur conducted towards the xiphoid process. The aortitis was in no way affected by salicylate treatment. Two subsequent radioscopic examinations at intervals of twenty months showed the progressive character of the aortic lesions, which were accompanied by slight though persistent pains in the joints as well as by deformi-

ties of the fingers and marked amyotrophy of the small muscles of the hands.

Rheumatic Aortitis. F. Bezancon and M.-P. Weil. Ann. de Méd., February, 1926, p. 174. (Reprinted by permission from Brit. Med. Jour., May 29, 1926, p. 89 of Epitome of Current Medical Literature.)

Ventricular tachycardia.—The authors state that this is an uncommon condition, and quote Scott's review of the subject in 1922, wherein he states that, of the twenty cases reported up to that time, the evidence concerning at least half of them is unconvincing. On the other hand, Wolferth and McMillan, writing on the subject a year later, report twenty-two cases of which they had no reason to doubt the diagnosis. Other writers are cited, so that the subject seems to be exhaustively covered in the present paper.

In the case reported in detail, a culture made from the patient's infected teeth was examined by R. L. Haden, who found an anhemolytic streptococcus, which organism showed a tendency to localize in the myocardium in the experimental animals injected with it. The authors believe that the association of focal infections with the myocardial infection in this case is a significant one.

Paroxysmal Tachycardia Associated with Focal Myocarditis. Ralph H. Major and H. R. Wahl. Jour. Am. Med. Assn., April 10, 1926, p. 1125.

Tests of liver function.—The authors have performed the tests during the last three years on a hundred cases either simultaneously or within an elapsed period of forty-eight hours, and in the present paper the results are published. The tests referred to are (1) the van den Bergh, (2) the Widal, (3) the Rosenthal, (4) examination of the urine for urobilin and urobilinogen, and (5) examination of the urine for bile salts. The results are presented in tabular form.

The conclusions arrived at are summed up as follows:

"It is important to bear in mind that these tests represent different functions of the liver, any one or more or all of which may become impaired. Again, one or more of these functions may escape injury. Therefore the various tests do not give parallel results. When we attempted to separate clinical cases into groups of 'liver disease' or 'no liver disease' by means of any one of these tests, unsupported by other clinical evidence, we were unable to do so.

"When all the tests were positive, we were dealing with liver disease, clinically of the most severe type; namely, toxic jaundice.

"When all tests were positive except one, namely, four positive and one negative, clinical liver disease was present, usually of a chronic type, such as that seen in Banti's disease or pernicious anemia and cirrhoses.

"In every case in which all the tests were positive except the Widal, there was obstructive jaundice due to tumor. This finding is of great value in differential diagnosis.

"When only three tests were positive it was impossible to correlate the findings with the clinical picture, as there were many cases in which liver disease was suspected which did not give positive reactions to more than one or two tests and, conversely, there were many cases in which liver disease was unsuspected which gave as many positive results.

"At present they are of use chiefly in the differential diagnosis and in following the progress of a given case. The greatest amount of information can be gained by doing all the tests simultaneously and repeating them often."

Liver Function Tests: A Comparative Study of Five Methods in One Hundred Clinical Cases. Samuel S. Berger, Milton B. Cohen, and J. J. Selman. Jour. Am. Med. Assn., April 10, 1926, p. 1114.

Rare tumors.—The author reports two cases of giant-cell tumors of the phalanges, one of the fourth toe and one of the thumb. He states that a thorough review of the literature shows only two cases of giant-cell tumor of the phalanges previously reported, making, with his two, only four cases reported and proven. These cases are interesting as showing the rarity of giant-cell tumors of the phalanges and their non-malignancy, not metastasing or recurring after thorough removal.

S. C. Barrow, M.D.

Giant-cell Tumor Involving Phalanges. Wallace H. Cole. Annals of Surg., March, 1926, p. 328.

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